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VIEWS, NEWS AND INTERVIEWS.

"Why am I chewing this straw?" reiterated an electric light salesman when the question was put to him. "I am learning to sell goods in Maine and this straw business is necessary to success. Down there everybody chews straws. They secure a straw of a certain length, about eight inches, and chew it up at a certain speed while engaged in making a 'dicker.' If a salesman can chew a straw of the proper length at the same speed as a native and finish with him neck and neck, it goes a long way toward the popularity of the salesman, and leads the native to think he is being treated as a brother. If you chew too slowly they'll beat down your prices, and if you chew too fast they think you're trying to gouge them. I've been practicing now for two months, and I'll soon be the most popular electrical salesman in Maine."

It is rumored in Wall street that a number of prominent capitalists are forming an electrical trust company for the purpose of handling electrical stocks and bonds. The scope of the company will be very similar to the plan proposed by Mr. F. Z. Maguire and described in an interview published in the ELECTRICAL REVIEW of February 14, 1891. It is said that the new company will be established on an independent basis, free from any alliance with existing electric companies.

The electrical business in New York and vicinity has been very dull for the past month and collections have been the same. Many companies are employing their forces in preparing for the autumn trade which promises well.

Decorative effects with low tension arc lamps are now the popular fad. One New York company is making over 40 styles of these lamps for interior work.

The use of the electric light is spreading to the most out-of-the-way parts of rural France, says a London exchange. Strolling players who travel about giving representations at the various rustic fairs generally include amongst their heterogeneous paraphernalia a small electric lighting plant, the dynamo being usually driven by the traction engine used for hauling the theatrical apparatus from town to town. Arc, not glow lamps, are preferred, and globes are conspicuous by their absence; so that the arcs serve the double purpose of giving light and of death-traps to the myriads of winged insects that are attracted by the beams. Spark protectors would, however, be a boon, as there are at times plentiful showers of hot carbon cinders, which, alighting on the spectators beneath, give rise to lively complaints. It is interesting to notice this enterprising use of the electric light, and credit is due to the rural blacksmiths who usually manage the plant. The lamps are generally remarkably steady and the brushes properly set.

Horse racing, bicycle racing and croquet are some of the out-door sports recently carried on at night by aid of the electric light.

Catskill Mountain Lightning.

REPRODUCTIONS OF INTERESTING PHOTOGRAPHS BY MESSRS. RUSK.

We have just received several very interesting photographs of lightning, three of which are reproduced in the accompanying illustrations. Figs. 1 and 3 are from negatives made by Prof. John W. Rusk, while Prof. Samuel E. Rusk made the negative from which Fig. 2 is reproduced. Both these gentlemen live at Haines Falls, N. Y., in the Catskill Mountains, and have had much experience in observing and photographing lightning flashes. Prof. Samuel E. Rusk is professor of natural science in Claverack College, Claverack, N. Y., and has had 20 years' experience in photography. We are informed that both gentlemen can furnish copies of the photographs from which these plates were made at 25 cents each.

The negative of Fig. 1 was exposed on July 22, at 9 P. M., and Fig. 3 was made July 29, at 5.30 P. M., from the porch of Prof. John W. Rusk's studio at Haines Falls. The horizontal discharge shown in Fig. 1 is about three miles long and shot along near the surface of the earth in a most peculiar manner. In the upper left hand corner may be noticed another discharge which seems to terminate in a star-shaped form. Fig. 3 is still more remarkable on account of the peculiar shape at the top and numerous fine diverging lines from the main discharge. These lines were too delicate to be reproduced in our illustration, but they may be distinctly seen in the original photograph with the aid of a reading glass. This discharge is of the "ribbon" form which was discussed in a paper read before the New York Electric Club, by Dr. M. G. Parker, of Lowell, Mass., and published in the ELECTRICAL REVIEW for November 24, 1888. Prof. John W. Rusk informs us that he has been making photographs of lightning for six years, and can make the pictures in the daytime as well as at night.

Fig. 2 is a very interesting picture, and was made in the evening of July 29 during the same storm that Fig. 3 was made. It was taken from Prof. Samuel E. Rusk's piazza at "Loxburst," Haines Falls, looking toward the Hudson River, some ten miles distant. He writes in regard to this discharge:

"The mountain over which it appears is Kaaterskill Mountain, on which Hotel Kaaterskill is situated. The flash is, I suppose, really beyond the mountain in the Hudson valley. From the main line are branches, scarcely noticeable in the print, but well seen with a small magnifier in the negative, extending downward from or upward to the main line, tapering and fading out at the farther extremities."

The detail in landscape, as shown in the original photograph, is really wonderful for this kind of a picture.

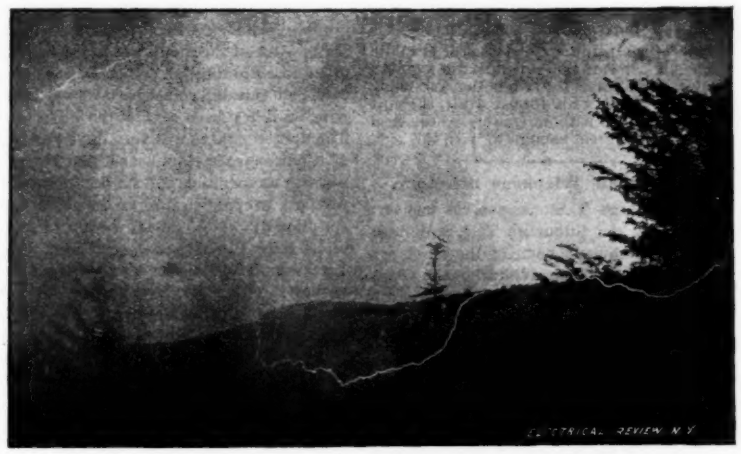

FIG. 1.—A LIGHTNING DISCHARGE THREE MILES LONG.—(From a Photograph by Prof. John W. Rusk.)

The Belgians Want an Electric Railway.

A demand for a concession to construct an electric railway between Antwerp and Brussels has just been made to the Belgian government by Mr. P. Van den Kerkhoven, of Ghent, says London *Industries*. The average time occupied in making the journey by rail at present is one hour, but by the electric railway it is proposed to reduce this to 25 minutes. It is probable, however, that the State railway authorities will intervene. Should it become necessary to establish an electric railway they would undertake it themselves. There is, however, certainly room for improvement in the speed on Belgian railways.

Telephony in France.

Paris will shortly be in telephonic communication with all the principal towns in France. There are already systems between Paris and Bordeaux, Paris and Lille, Paris and Lyons, and Paris and Marseilles, and the installations are continually being extended. At the beginning of July a line was opened between Paris and Beauvais.

The Great Telephone Case.

Alexander Graham Bell has finished his testimony before United States Commissioner Hallett, at Boston, in the case of the United States *vs.* the American Bell Telephone Company, and the defence will not attempt to take further evidence until September 1.

LIGHT AND POWER STATIONS.

SOME HINTS TO OWNERS AND OPERATORS BY A PRACTICAL ENGINEER.

Selection of the Station Site—Considerations Covering its Choice—Get Room Enough to Grow In—Possibilities of Advantageous Real Estate Purchases.

BY ROBB MACKIE.

IV.

Generally following the outline as previously laid down, the first serious question that presents itself for consideration is the location of the station. There are so many elements that have to be balanced in this that it is utterly impossible to lay down any iron clad rules to be observed in the selection of a suitable site. We have to consider the source of the fuel supply and the question of fuel storage. This latter is a serious matter if for any local condition there is a considerable range in the cost of fuel at different seasons, and whether that difference is sufficient to pay for the additional handling. Again the question of fuel storage is serious if there be any liability to have the supply cut off for any length of time.

Of equal importance with this is the water supply, a question to which so little attention has been paid in the selection of the sites for some plants as to be almost laughable if not showing such a lack of foresight on the part of the designers of the plants. It is not intended to advance the claim here that the site of a station must be selected solely with a view to the fuel and water supply, as there are other considerations which will form as important factors in this equation as the two specified, but I do wish to call especial attention to the fact that proper consideration is not given to these two important factors when sites for many stations are selected.

So much of the economy of the operation of the power plant depends upon these two elements, that it is almost impossible to believe they are so often overlooked in the lay-out of a station.

It must be remembered that local conditions bear largely upon the desirability of this or that location, the question of first cost not always being the only element to be considered; the cost of the wire and the loss on the lines must bear only a fair ratio in the selection of a location, and not be the only element to be considered, as has too often been the case. The style of apparatus to be installed and whether the electrical plant is to be used for arc, incandescent, power or all of them, also bear largely upon the decision of this question; while there is a very considerable difference whether you install high speed, low speed, compound or compound condensing engines and as to the number of hours per day it is proposed to operate the plant.

Each of these elements has to be carefully considered and given its fair share of weight in the decision of this question, and it is clearly evident that this should all be done by one whose mind is trained in the consid-

eration of such matters, rather than by those without experience, if the best results are to be obtained.

In the selection of the location and design of the building care must be exercised to secure property and erect a building that will first admit of an increase of machinery, and afterwards, allow for the extension of the buildings to admit of still further extensions of machinery. Experience has taught us that it is almost impossible to estimate the rapidity with which an electric plant

FIG. 2.—LIGHTNING OVER MOUNT KAATERSKILL, NEW YORK.

will have to be enlarged, but it has also taught us, in a way not to be forgotten by those who have been through it, that in a majority of cases the growth of the business is phenomenal and, therefore, it is imperatively necessary to design our plants with a view to the extension of the buildings, in harmony with the entire plan of operations. In this way only can we make preparation for the rapid growth of the business, so as to allow for a maximum of increase of the load with a minimum of cost of construction.

With this before us, it is well to remember that the value of real estate increases at times at a very rapid rate; therefore, by the exercise of judgment in the purchase of property for the location of the plant, the chances are strongly in favor of an increased value. In several cases the profits resulting from sale of property near the station, but not necessary for the enlargement of the plant, have been sufficient to pay for the necessary additions to buildings and machinery.

There are many cases on record where the natural development of the load on the station has been so great within a few years that it has been found that the design of the station and layout of the machinery is such that new machinery cannot be installed without materially changing the entire arrangement. At a considerable expense this is done, often-times to be followed at a little later day by the realization that even the extension does not afford sufficient facilities to handle the increased business.

Then, if it becomes necessary to secure a new site and erect a new station it will be found that the cost of transfer is greatly in excess of the usual calculations, for, as a rule, the "unexpected" happens adding vastly to the estimated cost of the work to be done. It will be found far more economical, in the truest sense of the word, to pay the interest on the cost of a larger building and the investment in a larger piece of ground, so as to have them when needed, than to go into this very expensive luxury of changing around all the machinery of a plant or of building and moving into a new one.

(To be continued.)

Annual Elections.

The annual election of the stockholders the Postal Telegraph Company was held on August 1, in this city, 6,000 shares being represented. The following directors were elected for the ensuing year: John W. Mackey, William C. Van Horne, George Stephen, Charles R. Hosmer, Richard V. Dey, Albert B. Chandler, Edward C. Platt, George G. Ward and William H. Baker. The Inspectors of Election were Edward Alden, Theodore L. Cayler, Jr., and John Doran.

The annual meeting of the stockholders of the California Electric Light Company was held at San Francisco recently. A total of 37,300 shares was represented and the following Board of Directors were elected: P. B. Cornwall, Gustave Sutro, Arthur W. Moore, George H. Roe, John R. Spring, William Kerr and D. Marcucci. The only changes from the old Board were the election of Arthur W. Moore to fill a vacancy caused by the resignation of Alvinza Hayward, and of D. Marcucci, who beat Frank H. Woods for the directorship lately held by Ramon E. Wilson. D. Marcucci represented an opposition faction, which made a lively fight for him, and won by concentrating all their votes upon him. The new Board organized by electing George H. Roe secretary and manager; Gustave Sutro president, in place of P. B. Cornwall; John R. Spring, vice-president.

Other Uses for Graphite.

A correspondent says: I have read an article on graphite, taken from the *American Machinist*. Let me say that I have used graphite for many purposes, some that the correspondent did not name, which I will give, as it may benefit some of my brother engineers, who, perhaps, have not experimented to any great extent with the article. I have used hand-hole and manhole gaskets eight to ten times by carefully smearing the surface next boiler shell, taken out at periods of three to four weeks, using steam pressure as high as 100 pounds. In packing water glasses, by putting a little graphite and oil on the gasket they would vulcanize as soft as lamp wick and retain their elasticity until the glass was changed, when the old rubber could be removed without trouble, while, by the old way, I have spent much time in digging out the rubber, baked hard as vulcanite. Another thing I used it for was after putting back my hand-hole plate or plugs in back connection, I carefully brush away all the soot and ashes, then with a small brush paint a good coat of graphite over flange, stud and nuts. After running boiler from three to six months, and using coke for fuel, with forced draft, the nuts can be removed without trouble, as the heat has not been great enough to burn the lead.

A Complete Telephone Directory.

Capt. George N. Stone, general manager of the City and Suburban Telegraph Association, which is the name of the Cincinnati Bell Telephone Company, has sent us a copy of his new telephone directory for August, 1892. It is one of the best arranged and most complete that we have seen. In the front of the book blank space is provided for the names and numbers of the subscribers called most frequently. Following this is a list of the Cincinnati fire alarm signal boxes and the fire signals. Then comes a list of the toll line offices connecting with the Cincinnati exchange. Then the city public pay stations are enumerated, and following this are the subscribers' names, which are easily found by means of an indented alphabetical index. An order for moving an instrument is bound in the back part of the book. The covers are tastefully printed in colors.

Electric Cars for Rent.

A novel feature of the Springfield, Mass., street car system is the letting of electric cars to parties who wish to hire. The price of a car is $2 an hour. It is convenient for a party to thus charter a car and ride as far as they desire. A car can be run over any of the lines, as they are under one management. When a car is thus hired a sign "special car" is placed on the sides. Many have been hired this Summer to run to different points of interest.

Sale of the Julien Electric Plant.

The remains of the old Julien Electric Traction Company will be sold by Richard V. Harnett at the New York Exchange salesroom on August 22. The "remains" consist of 16 cars and trucks now at Marion, N. J., and the electric plant at Eighty-fifth street and Madison avenue in this city.

New York Trolley Lines.

The Harlem Bridge, Morrisania and Fordham Railway Company, otherwise the "Huckleberry" road, is now known as the Union Railway Company. A $2,000,000 blanket mortgage has been placed to provide funds for extensions, improvements and the adoption of the trolley system.

The Railroad Committee of the Board of Aldermen gave a hearing on August 2 to the Union Railway Company. The petition asks for a franchise permitting the company to operate railroads in the following streets:

Macomb's Dam Bridge, through Jerome avenue to the city line.

Morris avenue, from Third avenue to Fordham Landing (or High Bridge) road.

Willis avenue, from the Harlem River to Melrose avenue, to Webster avenue, to Bronx River road, to the city line.

From the city line at the Bronx River along Tremont avenue to Webster avenue and Burnside avenue, along Burnside avenue to Sedgwick avenue and Cedar avenue, along Cedar avenue to Riverview Terrace, along Riverview Terrace to Sedgwick avenue, also along Dock street from Riverview Terrace to the tracks of the New York and Northern Railroad.

In Olin avenue, from Webster avenue to the city line.

In Boscobel avenue, from Washington Bridge to Jerome avenue.

From Fordham, across the bridge of the Harlem Railroad, to Kingsbridge road, to High Bridge road, to Sedgwick avenue, to Bailey avenue, to Broadway at Kingsbridge.

Along Sedgwick avenue, from Jerome avenue to the city line,

It is said that the necessary consents for right of way have been obtained from property owners.

Telephotography.

A young French chemist, M. Heri Courtonne, is credited by the Paris *Figaro* with a new discovery. Sound being transmissible by telephone, M. Courtonne argued by a rigorous analogy that light might be transmitted too. As the telephone consists of a transmitter, a wire and a receiver, there was reason to believe that these three organs might be adapted for transmitting light vibrations, and for this purpose the transmitter and receiver should be prepared chemically for receiving and giving out light instead of sound vibrations. This was done by substituting sensitized photographic plates for the ordinary telephone plate. One of the plates was placed in front of an aperture through which an image was cast, and this image has been forwarded by wire, and has been seen at the other end. The first apparatus was very imperfect, and M. Courtonne, having heard that Mr. Edison was on the track of a similar discovery, resolved to publish his experiments, a description of which he, however, sent in a sealed letter to the Academy in 1889. This letter is only to be opened at the sender's request. The *Figaro* says: "That the consequences of the telephotography cannot be over-estimated. To-morrow you will see in Paris the image of a man smoking in St. Petersburg."

ELECTRICAL PEOPLE WE MEET.

George F. Porter, secretary of the National Electric Light Association, is one of the old-timers. He was at one time connected with the Pullman Palace Car Company and for many years was one of the mainstays of the Pittsburgh Carbon Company, now known as the Faraday Carbon Company. After this he associated with Mr. C. A. Bragg in handling the Philadelphia business of the Westinghouse Company. The carbon business again claimed Mr. Porter's attention for a short time and then he was appointed to his present position by President Huntley, being reappointed by President Ayer. Mr. Porter knows everybody in the electrical business and is a valuable officer of the National Electric Light Association. He is intelligently posted on current affairs and can relate interesting anecdotes of the Mollie Maguires, the Pittsburgh railroad riots of '77, the Johnstown flood, and the politics of the Keystone State, which he swears by.

No man devoting his time and talents to the electrical industry possesses a larger or more friendly list of acquaintances than does Mr. Eugene F. Phillips, president of the American Electrical Works, Providence, R. I. Mr. Phillips inaugurated some 14 years ago the pleasant feature of giving an old-fashioned Rhode Island clambake to his friends and customers in the electrical field. The one of this year was greatly enjoyed July 23 and very largely attended. For 14 years these clambakes have been held and on each occasion the clerk of the weather has shown his friendship and regard for Mr. Phillips and has seen that the sun has shone and that the rain did not fall. Mr. Phillips visits New York as a rule once a week, making his headquarters at his New York office on Cortlandt street, where Mr. P. C. Ackerman holds forth as the very capable and active New York manager.

Mr. A. M. Young, of Waterbury, Conn., is a frequent visitor to the city. Early realizing the possibilities of electric traction, Mr. Young made a study of the future of such business in several Southern and Eastern cities, then invested in franchises, and he is to-day at the head of a number of syndicates controlling valuable electric railways and electric lighting systems. Starting without large means Mr. Young, though a young man in the thirties, has the satisfaction of counting up his wealth in the neighborhood of $250,000, and his success may be attributed solely to his careful hard work and good judgment in selecting progressive cities in which to operate. Mr. Young is the owner of considerable property at Crescent Bluff, near Pine Orchard, Conn., where he has a beautiful cottage. A number of other handsome cottages have been erected on the bluff, which is crescent shaped, nearly all being owned by Waterbury people.

Mr. Seymour Hess, son of Electrical Subway Commissioner Jacob Hess, is a promising young actor. Last season he was with "Mr. Wilkinson's Widows."

Mr. J. J. Carty is the telephone engineer of the Metropolitan Telephone & Telegraph Company and the technical head of the telephone business in New York. Mr. Carty has an enviable reputation as an electrical expert, an inventor and a scientist. The Carty system of "bridging bells" is a valuable device well known to telephonists. Mr. Carty possesses a well-trained logical and philo-

FIG. 3.—A PECULIAR LIGHTNING DISCHARGE IN THE CATSKILL MOUNTAINS.

sophical mind and has marked ability as a writer. His essays on scientific subjects have a peculiarly charming style and always attract attention. He is a self-made man, having begun his career in the Boston telephone exchange. Mr. Carty was married about a year ago to Miss Russell, of the Madison Square Theatre Company, and lives in charming apartments in Harlem. He is just now enjoying the pleasures of a happy father, and declares that the first word ejaculated by his son and heir was "Hello!"

BI-POLAR.

The Electric Percussion Drill in Theory and Practice.

READ AT THE GENERAL MEETING OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, CHICAGO, JUNE 7, 1892,

BY HARRY N. MARVIN.

Wherever rock is to be excavated, in mining, tunneling or quarrying, there of necessity we find the percussion drill. Until about a year ago two types of drills held the field, the hand drill and the direct acting steam or air drill. With the extension of electric methods of power transmission to mining operations came the urgent demand for an electrically operated percussion drill. The mechanical and electrical requirements of this machine are particularly severe; it is called upon to continuously endure an action that is, almost all other machinery, studiously avoided, namely, a practically uncushioned reciprocation and a blow upon substances harder than cast iron. The general requirements of an electric percussion drill for mining work are that it shall be light enough to be quickly handled by two or three men; it must be powerful enough to compete with an air drill that absorbs eight or ten horse-power; it must be so simple in its design that it can readily be repaired by an ordinary mechanic without electrical experience; it must be so constructed that the complete machine and its several parts can be soaked in mud and water without injury; it should be incapable of burning out, it must be able to endure almost any amount of the roughest handling without injury, and the materials employed should be as little subject to crystalization as possible. My experience suggests the following elements of construction to be avoided: Traveling conductors, commutating or current shifting devices, sliding contacts, spring contacts, cotton insulated wire and all insulating material capable of carbonization, switches, lamination of the moving parts, close fittings and joints liable to be impaired by considerable wear, all constructions liable to be impaired by careless or unskilled attention. For the benefit of those unfamiliar with the actions of the air drill, I will state that the general practice at present is to give the machine a stroke of from five to seven inches, to strike as nearly as possible an uncushioned blow upon the rock and to make as many blows per minute as the power applied will develop, usually from 200 to 400 per minute. It is found that a stroke of about five inches is necessary to properly free the hole from mud.

In the electrical solution of the problem the solenoid and plunger affords the simplest method of developing this action, and most of the work in this field has been confined to this line. After much experimental work with divided solenoids and commutating devices mounted upon the drill, I abandoned these methods, and in 1888 devised the system of operation that is at present rather well known, but for clearness this may be illustrated.

Fig. 1 shows an ordinary continuous current dynamo having two opposite points of its armature connected to a solid collecting ring and a half ring, respectively. The outer terminals of the drill coils M^1 and M^2 are connected by line wires to the two brushes, alternately bearing upon the half ring. The inner terminals of the coils are joined and led to the solid ring. It appears that as the armature revolves current impulses are directed into the drill coils in alternation, causing a reciprocation of the plunger in synchronism with the dynamo armature. It will be noticed that the action here closely resembles the action of a steam engine, force being exerted first in one direction and then in the other, one end of the cylinder being idle while the other end is active. Of course, connections are such that the polarity of the plunger is never reversed. This system simplifies to the utmost the construction of the drill and enables it to be so designed as to satisfy all of the conditions before mentioned. The complications of this system are more apparent in theory than in practice. Three wires are required, but once placed they give no further trouble. The generator can be used to develop continuous currents and pulsating currents at the same time if desired, but I believe that it is better practice to use a separately excited drill generator without regular commutator. The machine then becomes extremely simple, as shown by Fig. 2. I have found it desirable to run these drills at a speed of about 400 per minute, a rather low speed for small dynamos. This difficulty may be avoided at the expense of simplicity in several ways. One method is shown in Fig. 3. The regular commutator of a continuous current armature is equipped with a pair of revolving brushes B–B^1, one of which connects to the solid ring of the drill circuit commutator and the other to the half ring. In this manner pulsations are developed in the drill circuit as the brushes B–B^1 are rotated, and with a frequency entirely independent of the armature speed. With this arrangement we are also able to take off 100 volt alternating currents from a commutator that is also supplying a 500 volt continuous current circuit, by spacing the brushes B and B^1, an amount less than 180 degrees.

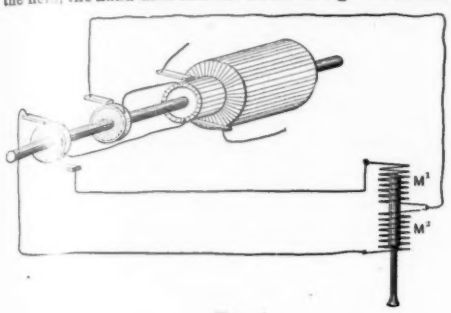

Fig. 1.

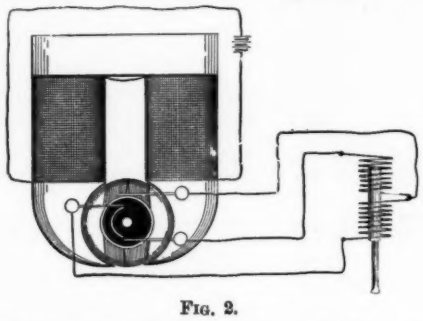

Fig. 2.

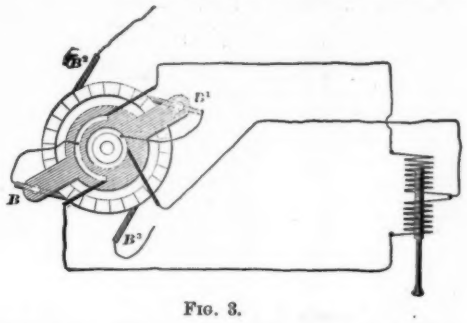

Fig. 3.

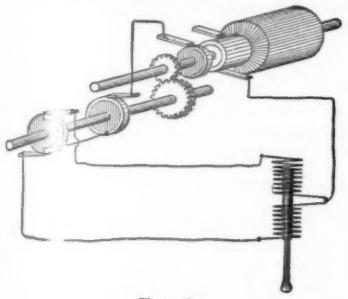

Fig. 4.

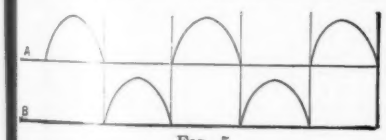

Fig. 5.

Another method of reducing the frequency of the pulsations is shown in Fig. 4, where the drill commutator is geared to the dynamo shaft, reducing the frequency to one-half the speed of the generator.

The general character of the impressed electromotive force in the two drill circuit in the above systems is shown in Fig. 5, curve "A" showing the voltage over the upper coil, and curve "B" showing the voltage over the lower coil.

A method of operation by which a somewhat different curve is obtained is shown in Fig. 6. It will be noticed that here current is admitted to the drill circuits when the voltage is at a maximum, the curve of impressed electromotive force being generally as shown. The general plan of admitting the current alternately to the two drill circuits, one circuit being idle while the other is active, characterizes all the above methods. This may be called plan "A."

I have devised a method for effecting this without commutation, as shown in Fig. 7. Here one wire from a simple alternator is led to the drill while the other wire passes through the secondaries of two converters C,C^1. The cores of these converters are continuously saturated by continuous currents in the primary coils as shown, the windings of the converters being opposite. When current endeavors to pass through these, it is checked considerably in the converters whose magnetism it tends to reduce and to a much less degree by the converter whose magnetism it tends to increase. A reverse current is opposed by the other converter and thus pulsations of one polarity are strong in one coil, while those of the reverse polarity are strong in the other drill coil. This would not probably be a very efficient method.

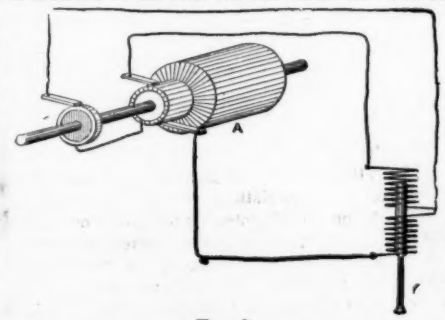

Fig. 8.

Another general plan of drill operation, which I will call Plan "B," has been developed to some extent by the late Mr. Van Depoele. This plan is based on a difference of phase of current in the two coils, and is shown in its simplest form in Fig. 8. The two outer drill wires are connected to the two regular brushes of the armature "A," and the middle wire connects to the solid ring connected to one point of the armature. As the armature revolves, current rises in one drill coil and falls in the other, producing the reciprocation of the plunger. The voltage curves for this type of machine are shown by Fig. 9. An armature giving two alternating currents of 90 degrees difference of phase may also be used, but with the disadvantage of reversing the polarity of the drill plunger. The above appears to be less efficient than Plan "A" for the reason that the drill coils are constantly working against each other, and being heated up by current opposing the action of the drill.

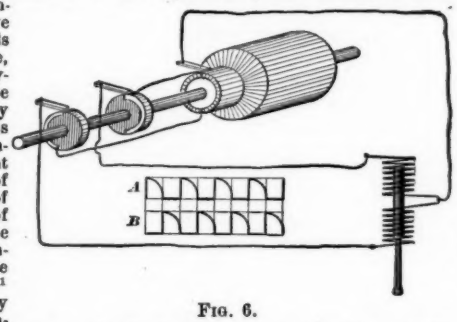

Fig. 6.

A third plan of operation, which we may call Plan "C," is that devised by Messrs. Siemens & Halske and shown in Fig. 10. Here three coils are used in the drill, the middle coil being excited by a continuous current and the two end coils by an alternating current of proper frequency. The function of the middle coil is to maintain a constant polarity in the bar, and the motion is effected by the effort of the two end coils. In this system both motor coils are continuously excited as in Plan "B," but there appears to be less waste of energy.

Aside from the extra complication of drill construction, it is questionable if as much power can be obtained from a given weight of wire with this arrangement as can be realized on Plan "A." It must be borne in mind that in these machines it is necessary to get the utmost power possible out of a given weight of copper and iron, and the heating limit is the only practical consideration. The efficiency of the machine is secondary.

Plan "C" has been reduced to practice in this country by the late Mr. Van Depoele, who avoided the use of a fourth wire in the system by an ingenious method shown in Fig. 11. The regular commutator "A" is supplied with rotating brushes B^2 B^3 in addition to the regular brushes B B^1. It appears that as the rotating brushes revolve, a simple alternating current flows through the end coils of the drill, while a unidirection pulsating current of one-half the frequency circulates in the middle coil.

The requirements of construction and service have thus far induced me to employ a rather low voltage in the operation of drills, our present practice being to use about 100 volts alternating upon the drill. I have employed several methods of operating drills from high voltage circuits.

Referring to Fig. 3, if the regular brushes B^2 B^3 be connected to a 500 volt circuit, the armature will run as a motor, and if the rotating brushes B B^1 be spaced by a suitable amount, less than 180 degrees, they will take off the pulsating current for the drill circuit at, say, 100 volts.

Another method is shown in Fig. 12, where a 1,000 volt alternating circuit is led from the prime generator "A" to the vicinity of the mine, where it passes through the primary of a converter "C," in which the voltage is reduced to 100 volts. A small motor "M," running in synchronism with the generator "A," directs the alternate pulsations into the drill circuits.

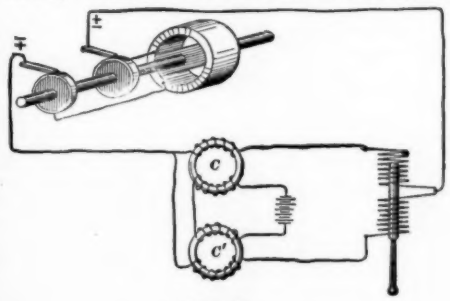

Fig. 7.

Turning now to the drill construction, Fig. 13 shows the first form in which the percussion drill was put upon the market. This I call a Type "A" machine. As appears in the sketch, the machine consists of a seven inch boiler tube provided with a suitable mounting. Within the tube are two solenoids B B^1, a rotating device and a cushion spring. Traveling through the coils is a two inch plunger "D," the middle portion of which is of iron; the upper end is of brass and is rifled as shown to fit the rotating device; the lower end is also of brass and is enlarged at the end into a chuck to hold the bit. The three sections of the plunger are welded together. The weight of this plunger was 38 pounds. This machine was designed to make 600 blows per minute with a three inch to four inch stroke. The first of these machines to be put into a mine was that started in May, 1891, in the Black Bear mine at Gem, Idaho. This was, I believe, the first commercial electric percussion drill plant ever operated. During the next few months several other mines and quarries were equipped with these drills, with the general result that where the rock was not excessively hard the work was fairly satisfactory, but in extremely hard rock several defects developed. The brass portion of the plunger would crystallize and break a short distance above the chuck. Under the severe strain of continuous work in hard rock the coils would become so heated as to ground, and the spring connections between the cable and the coils would give out. The construction of these drill coils deserves special description; Fig. 14 shows a coil complete ready to be put into the drill. The coil is constructed as follows: Upon a brass spool, the body and heads of which are insulated with mica, is wound a bare copper wire of square section; this wire is insulated as it is wound with mica. The complete coil is wrapped with mica and a metal tube slipped over the whole and soldered to the coil heads, making the completed coil water-proof and heat-proof, as it is insulated with mica alone, nothing but mica and metal being used in its construction. The trouble with our first coils was that they were soldered up with a comparatively soft solder, and when the coils got very hot this solder softened, the joints opened, and oil and dirt getting in carbonized and developed a ground. As an example of the treatment these drills received I will state that while visiting one of our drill plants, that was used for railroad grading on the Great Northern Railroad in Idaho, I saw the men dump one of these drills bodily off from a flat car onto a dump of broken stone, down which the drill rolled some 20 feet. I might add that this was one

of our most successful plants, 18 foot holes being regularly drilled in granite rock. In view of the defects mentioned the design of the machine was altered as shown in Fig. 15, which shows a Type "B" machine. The

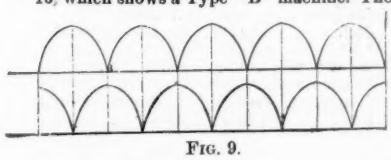

FIG. 9.

plunger has been enlarged to two and three-quarter inches, and is what I call the double magnet type. The forward part "D" is now made of steel, the rifled part D^2 is also of steel, and the connecting piece D^1 is of brass. This design gives a solid steel chuck and brings the brass part of the plunger within the drill body. The coils are now encased in boiler tube jackets brazed up with hard spelter, and are heated to a bright red in process of manufacture. The spring connections have been abandoned and solid set screw connections now connect the cable to the drill. A switch is inserted in the cable near the drill. This machine seems to overcome the defects of the old drill, and has thus far proved very satisfactory. This machine takes a stroke of about five inches and runs at about 380 blows per minute. This longer stroke is found more effective in keeping the hole free from mud.

Fig. 16 shows a still later type of drill that I have recently built and which promises to

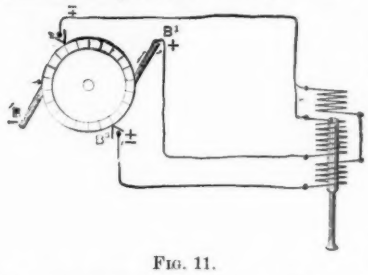

FIG. 11.

be much better than the others. The outside dimensions of this machine are about the same as the Type "A" machines, but the plunger of this machine is a solid steel forging and four inches in diameter. No brass is used in the plunger, the metal being reduced in section where it passes through the front head. The ratchet device is similar to

FIG. 14.

that used in air drills, and, in fact, the whole design of the machine quite closely follows the air drill construction. This machine takes a stroke of from six and one-half to seven and one-half inches and makes about 380 blows per minute; the plunger weighs 80 pounds.

Fig. 17 shows the cable connection and switch "A," and the cable fuse box "B," through which connection is made from the mains to the cable. A study of the operations of these machines presents many interesting features. In Fig. 18 is shown what I term an energy curve of the machine. This curve is obtained in a manner similar to an indicator card of a steam engine. Referring to Fig. 19, "A" is a cylinder mounted parallel to the drill rod. This cylinder is

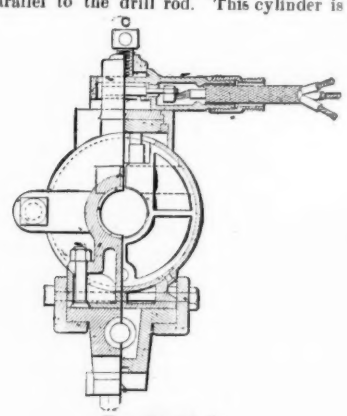

FIG. 13, "A."

geared to the armature shaft in such a manner that it rotates in synchronism with it. A pencil carried by the drill rod rests upon the cylinder "A"; it appears that as the drill rod reciprocates and the cylinder "A" rotates, a curve will be traced by the pencil. Fig. 18 shows such a curve. The direction of motion of the paper being from left to right, it appears that the angle X of the curve at any point indicates the velocity of the plunger at that instant. "A" is the point where the plunger strikes the rock and the sharp rebound is shown by the angle. The concave character of the curve at "M" shows the backward acceleration of the plunger. The buffing spring is encountered at "S," and the angles at S and S^1 show that there is little loss in the spring. The angle X gives the final velocity of the plunger when it strikes the rock. A simple calculation gives the energy of the blow in foot pounds. This affords a good method of comparison between different machines and conditions. The general character of the curve reveals the general action of the forces during the stroke. The curve in Fig. 20, for example, shows that the drill rebounded sharply at "A" and then stood still for a considerable time at "B," indicating that the stroke was too short for the power applied and the frequency of the stroke. On Fig. 21 we have shown the reverse conditions where the concave character of the curve at "B" indicates a loss of velocity and the length of stroke is evidently too great for the power applied. Fig. 22 shows a curve taken on a Type "A" drill with an 18 foot bit drilling downward in slate rock.

The energy of the blow being determined it can then be decided whether the drill delivers the greater amount of energy upon the rock by a few long strokes or by a greater number of shorter strokes.

Some other interesting curves are shown in Fig. 23. Curve "A" shows the voltage on the drill circuit. Curve B and B^1 the current in the two coils. Curve C is the energy curve. The lines D D^1 indicate where the brushes make contact with the half ring.

The efficiency of the above machines compared with other forms of electro-motors is, of course, low, but this factor is of comparatively little moment in percussion drill work. It is far more important that the machine should be able to endure the development of a large amount of power with a small weight, than that it should be highly efficient. It would seem that the general mechanical design of these machines admits of greater durability and simplicity of construction than air drills, as there are no steam tight joints required and a very great wear upon the moving parts does not reduce the effectiveness of the drill. The general flexibility of the electrical system and its peculiar adaptation to mining work

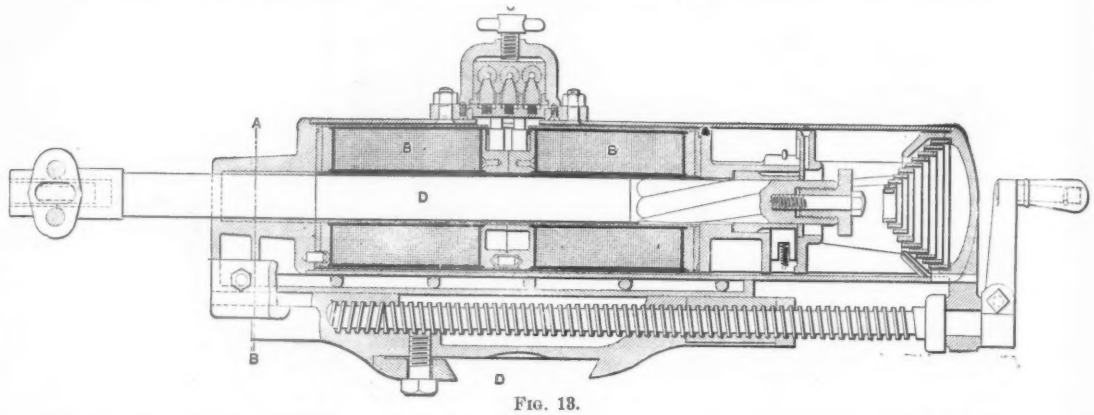

FIG. 13.

LITERARY.

We have received the "Journal of the Institution of Electrical Engineers" (London) for July, 1892.

"Report of the Ninth Annual Meeting of the Street Railway Association of the State of New York" has been received.

The introduction to "Poor's Manual of the Railroads of the United States" for 1892 has been received. The manual promises to be better than ever this year.

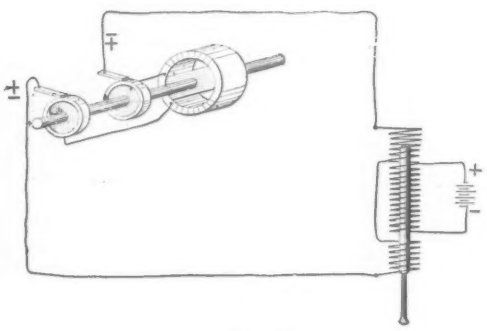

FIG. 10.

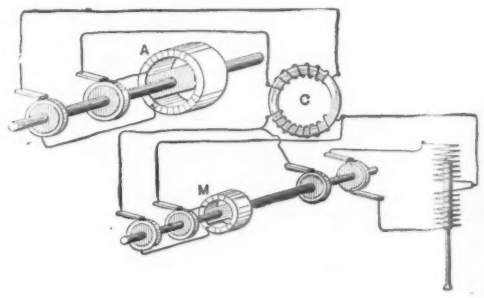

FIG. 12.

"Street Railways; Their Construction, Operation and Maintenance," by C. B. Fairchild, editor of the *Street Railway Journal*. This is a practical hand-book for street railway men and its author is recognized in tramway circles as one who knows of what he writes. The work is the outcome of actual experience and covers the field completely, and in such a detailed and thorough manner as to make the book invaluable to every street railway man. Horse roads, cable lines and electric power methods are covered in full. The chapters on car building, track construction, discipline and accounts, are carried out minutely and thoroughly, forming a wonderful compendium of practical information. This book is not to be read and laid aside, but is designed to be a thumb-worn text-book. It is about the size of the *Street Railway Journal*, has nearly 500 pages and over 700 illustrations. We desire to recommend every one interested in the street railway industry to buy a copy of this work and keep it handy for use at all times.

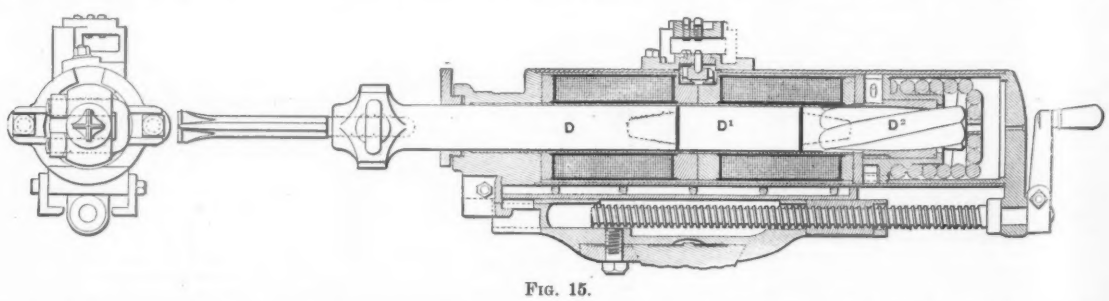

FIG. 15.

The Sheridan Building at Denver, Colo.

A distinct progress in the application of electricity has been inaugurated in the Sheridan Building, owned by Mr. J. H. Ernest Waters, and erected by him exclusively for light manufacturers in Denver, Colo.

This building, erected after the plans of Messrs. Paerresen Bros., architects, of Denver, is designed for the use of light manufacturing, watch-case makers, brass finishers, etc., and contains some 20 odd rooms above the ground or store floor adapted to the above uses.

In this building is installed, we believe, the first plant in the world for the distribution of power to the several tenants by wire exclusively, instead of by belting and shafting, after the usual practice.

The power plant, located in the basement of the building, consists of two 60 inch return tubular boilers, one 165 horse-power Fraser & Chalmers Corliss engine and one 40 horse-power Straight Line engine.

Belted through a countershaft to the Corliss engine is an 80 kilowatt "C. & C." dynamo, wound for a pressure of 180 volts, and to the 40 horse-power Straight Line engine is belted direct a 20 kilowatt "C. & C." dynamo, wound for the same pressure.

The switchboard in the engine room is built of Vermont marble, and is 16 feet long. On this board is located a distributing circuit for each tenant in the building, and in each circuit is an amperemeter, thus showing the amount of power used by each tenant, and thus keeping the supply of power constantly under the supervision of the engineer. The large engine and dynamo supplies the light and power during the day, and the 40 horse-power plant such light and power as may be required after 6 P. M., the circuits being so connected at the back of the switchboard that either or both of the dynamos may be connected to the supplying circuits of the building.

The steam plant was designed and erected by Messrs. Fraser & Chalmers, Chicago, and the electrical plant and the distribution of light and power by the "C. & C." Electric Motor Company, New York.

Reminiscences of the Thomson-Houston Company.

At the recent anniversary banquet of the Thomson Scientific Club, of Lynn, Mass., Supt. E. W. Rice, Jr., was one of the after-dinner speakers, and his contribution to the feast was very rich indeed, both in humorous reminiscences and statistics of the wonderful growth of the Thomson-Houston Company.

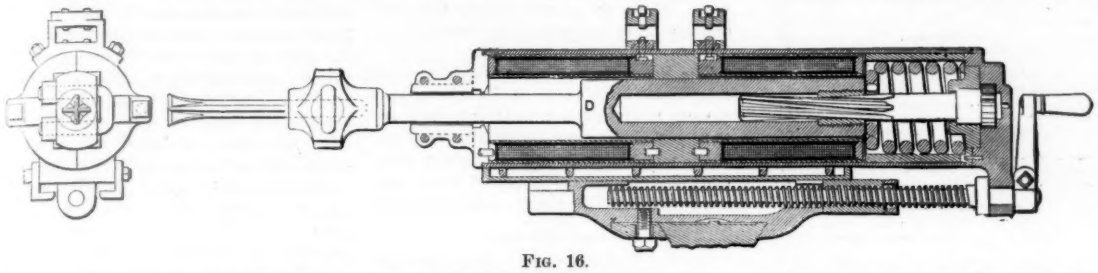

FIG. 16.

The superintendent remarked that he was one of the early employés and was the first expert. That was in the days when the works were primitive and infantile, and the length and breadth of the Nutmeg State held no more doubtful enterprise. One of his first duties was to wipe off the grease from a new machine received at the factory, and the next important task was to whitewash Professor Thomson's office. Afterwards he resumed the employment of wiping

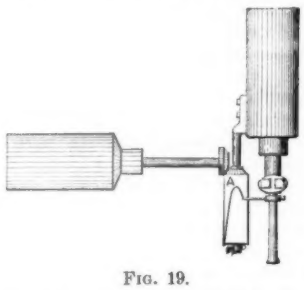

FIG. 19.

grease, and meanwhile acquired an easy familiarity with the most approved methods of killing time.

"I remember one occasion," said Mr. Rice, "when we were working nights, as men will do when business is slack, and we felt the need of a light lunch. Professor Thomson was there and all we had to eat was some raw oysters. The professor objected to eating raw oysters. It was easy to cook them over a Bunsen burner, but we had no butter. Here was an opportunity for inventive suggestion, and the professor

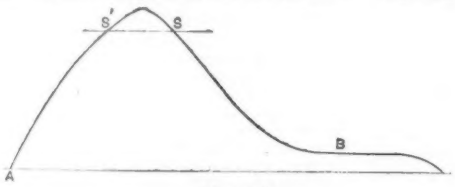

FIG. 20.

was equal to the occasion. A barrel of fine white paraffine was at hand and we made a substitute of it for butter.

"It went very well," said the superintendent, smiling at the recollection, "but it did have a certain candle-power to its flavor."

After two years there was a selling out to a syndicate, and when Mr. Coffin made the acquaintance of the struggling enterprise there were not above 90 men employed. In 1885, when Mr. Rice became superintendent, the number had increased to 140. The superintendent modestly alluded to the fact that the present roll at the works exceeds 3,800 names, and facilities were to be enlarged at a very early date.

Looking over the shipments for one week, ending May 7, the figures were remarkable. The combined power apparatus sent out was over 5,000,000 watts, or 7,000 horsepower. The amount of material employed during one year was another stupendous item. Of iron of all kinds, 18,000,000 pounds were used, at a cost of $500,000. Of copper, 6,000,000, worth $1,000,000. Of brass, 2,000,000 pounds, worth $320,000. The pay roll was $1,600,000. Total purchases of material equalled $3,500,000. The output of the factories for one year was about 2,000 car loads, at 20,000 pounds to the car, enough to make up 100 full trains. The pay roll is now $44,000 per week; it requires $75,000 a month to run the factories.

Illustrating the rapid growth of railroad work, these are the figures: 92,000 horsepower developed in motors up to the present time, 5,000 in one week of the month of May. Yet with the capacity of the works it would take only nine months to duplicate all power put out. In January, 1890, there were 80 railway companies using electricity; in January, 1892, there were 204, using 2,769 cars with 2,363 miles of track. Since the beginning of the year 243 companies have equipped 4,569 cars and 2,636 miles of track.

The business done in 1883, when the Lynn management took control, was $426,000. It was $10,304,000 in the latest fiscal year. Since the consolidation it has been decided to do all the engineering work of the General Electric Company in Lynn. The superintendent said to the experts and engineers around the tables: "To you, gentlemen, the whole world will look for the electric power of the future."

Mr. Rice had had an application from a very sanguine young man who desired to be an expert. "He wrote," said the speaker, "that he was by natural inclination, hereditary transmission and predestination cut out and adapted for electrical pursuits. I thought, gentlemen, we might all lose

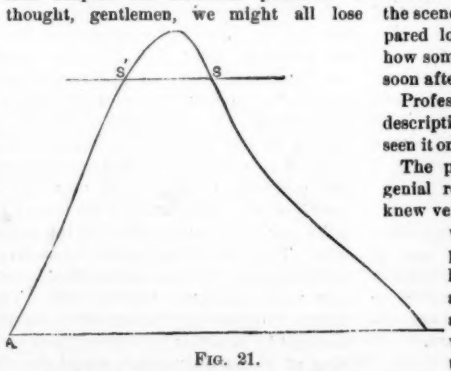

FIG. 21.

our jobs if this extraordinary foreordained electrician was to enter the field. I doubt not but we shall hear from him and perhaps lose ourselves in the brilliancy of his predestined and hereditary power."

Like Solomon Gills' Madeira, Professor Thomson was reserved for the last at the Scientific Club feast. One hardly realizes that a wizard stands before him as the professor rises with a boyish smile and a greeting that is geniality and good-fellowship itself. One looks in vain for the freezing reserve, austere dignity, profound and protruding importance that is naturally to be expected in the man who stands pretty near the focus of the world's eye to-day. How the professor escapes the trials and sufferings of great men without a vestige of the armor which great men are accustomed to wear is a problem. Among all the men in the electric oligarchy the professor is least changed from the simple thinking, engaging school teacher he once was. There is a delightful element of hope in the professor's make-up. He lingers not so much in the present as he reaches out into the future. It is to-day and the things thereof that concern the works; it is to-morrow and its boundless possibilities that concern the professor.

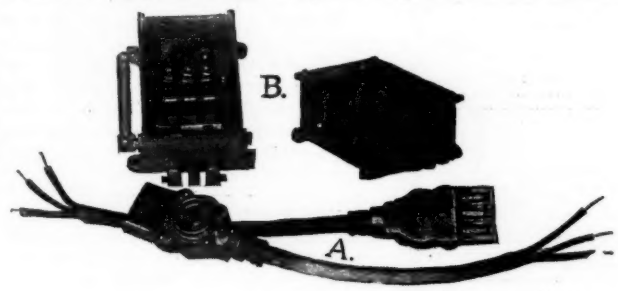

FIG. 17.

As a first topic Professor Thomson told how the expert originated. In the early days when a machine was put out to service no one dared to touch it. If a commutator brush needed adjustment there was a call sent to the works for an "expert" to come out and fix it. Sometimes when no one could be spared from the small force of skilled mechanics, the office boy was instructed in the simple process, and went to the scene of trouble wearing a carefully prepared look of profound wisdom. This is how some of the boys became experts very soon after entering the business.

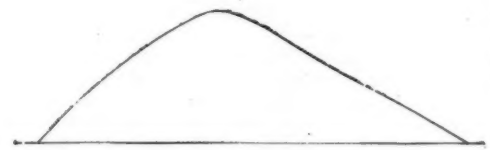

FIG 22.

Professor Thomson went into a glowing description of the World's Fair, as he had seen it on a late trip with Lieutenant Spencer.

The professor assumed his always congenial role of an electrical prophet. He knew very well that the time was coming when gas would be a thing of the past. In the early days of electric lighting every slur was uttered against it by the gas men. There was a shrewd gas director in New York who was not all alarmed at the introduction of electric arc lamps in the streets. He said it was a good thing, and why? Because under the brilliancy of the electric illumination every storekeeper felt it necessary to increase his own radiancy and the use of gas was greatly enlarged, to the satisfaction of the director and his colleagues. However, they quietly moved around and secured electric stock wherever they could lay their hands on it, for gas was doomed.

How much can be derived from a ton of coal was an interesting revelation. A pound of coal, coarser fuel it may be also, will produce five or six incandescent lights to one gas jet, or while 2,000 gas lights an hour can be derived from a ton of coal, the same fuel will suffice for 8,000 incandescents an hour. The incandescent lamp may be made to last longer and the cost of generating reduced. When every economy has been instituted it does look as if the time for the universal use of electric lighting will have come.

There is a difficulty in the way in the hanging of wires and the cost of fixtures. The latter are by no means as simple as they will be made in the future. The professor thought the best system to be devised was the concentric system, a single wire, carrying a high potential enclosed in a pipe, and the return to be on the pipe. The pipes could be made in sections, with sleeves, elbows and connections to be screwed into place, the whole, as easily introduced as gas piping. The system guarantees safety from shocks, and is much cheaper than the double wire system.

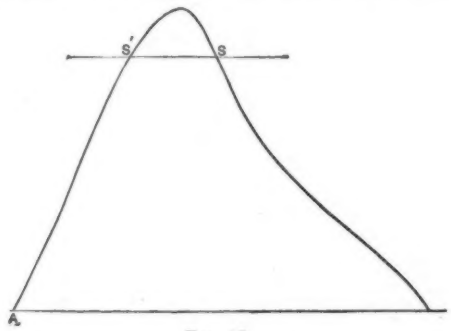

FIG. 18.

Prof. Thomson thought electricity could

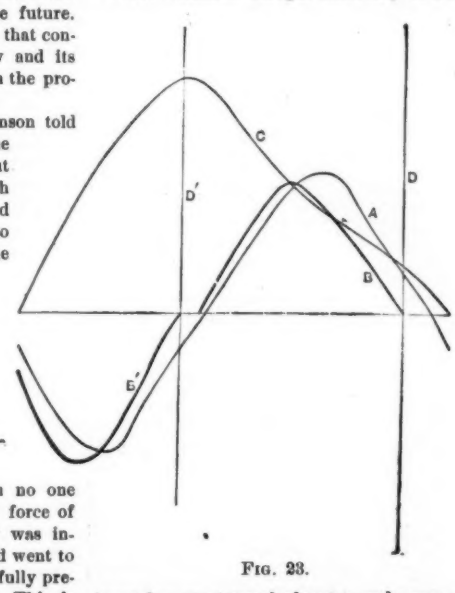

FIG. 23.

be made a great moral educator and correction. As a chastisement an electrical shock would be quite effectual. There would be the dread of knowing it was coming. As a discipline of the mind the study of electricity has done more than any other thing.

Brooklyn Bridge Cables.

One of the cables now in use on the Brooklyn Bridge Railway has been in service for 415 days, has made 88,590 miles, and has handled a total traffic of 26,502,183 ton miles. It was made by the John A. Roebling's Sons Company, and is said to be still in good condition. A cable made by the same firm, which was formerly used on the bridge, was in service 607 days and ran 120,282 miles. The trains at that time weighed 212 tons, against 299 tons at the present day, so that the total traffic was 25,492,862 ton miles, or somewhat less than the cable now in use has already carried.—*Engineering News.*

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ROBERT H. READ.

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There are over $800,000,000 invested in the electrical industry in this country. How's that for an industry that is yet "in its infancy?"

After two months of uneventful electrical work, there are abundant indications of reviving activity. It may be expected that the fall business in the electrical field will exceed that of any previous season.

The electrical inventor is as active as ever. Our column of patents issued each week is speaking proof of this statement. No science possesses more thoughtful and alert minds than have been attracted to this fascinating field of work.

Consolidations, a presidential year and the hot weather, have been assigned as the reasons for an unusually dull summer season. With the advent of cooler weather and the return of the seaside pilgrims, business should pick up, and we predict that it will.

There are several developments promised in the telephone field during the next 12 months. Just how much will be undertaken in the way of new companies organized to replace the present long established exchanges, is as yet beneath the surface.

The growth of electric traction reminds us of the farmer who was discovered standing at the foot of a cornstalk, with eyes raised in anxiety. "How's your corn?" was asked. "I don't know. Sent one of my boys up to see, and the cornstalk is growing up faster than he can climb down!"

The Electricity Building at the World's Columbian Exposition covers more ground than the capitol at Washington. This very new industry may be expected to cover itself with highest honors at the Exposition next year. The space alloted, large as it is, will scarcely prove adequate to the demands.

The Strowger automatic telephone is to receive its initial trial at La Porte, Ind. Seventy-five telephones, we are informed, are to be put in free for six months on trial. Every telephone man and particularly every telephone girl, will be interested in the outcome of the trial of this automatic telephone exchange.

One hundred and seven new subscribers to the REVIEW in one week is a source of gratification to the publishers, as well as an indication of the substantial increase of interest in electrical matters. If you wish to keep posted on the entire electrical field—popular, practical and scientific—read the ELECTRICAL REVIEW.

Murderer Joseph Wood was electrocuted at Clinton Prison, Dannemora, N. Y., about 11 o'clock in the morning of August 2. He received four shocks of 1,500 volts. The doctors thought he was killed at the first shock, and the newspaper reports state that the horrible details of other electrocutions were not evidenced in this case.

New York is the American metropolis and has fewer miles of trolley roads than a little interior town out West. But this bids fair to be changed. The "Huckleberry" road, operating in the extreme northern portion of the city, has asked permission to adopt the trolley system, and has $2,000,000 to spend in installing it. Success to the enterprise.

ELECTROCUTION.

There is, however, no reason, says the *English Mechanic and World of Science*, why electricity should be used for the purpose when, years ago, Dr. August Smith's experiments on the asphyxiating power of carbonic acid gas pointed clearly to the simplest and easiest way of executing criminals—a method found efficacious in the shape of Dr. Richardson's "lethal chamber" for dogs.

GAUSS AND THE TELEGRAPH.

The first part of the report on the proceedings of the Frankfort International Electrical Congress has been published, and contains a most interesting letter, reproduced in *fac simile*, by Gauss, written in November, 1833, and recently found by Professor Schering, Gauss' successor in the magnetic observatory of Göttingen. In this letter Gauss says: "I am convinced that by employment of sufficiently stout wires one could in this way, *with one blow*, telegraph from Göttingen to Hanover, or even from Hanover to Bremen." This letter was communicated to the meeting by the president, Dr. Werner von Siemens.

ELECTRIC RAILWAY DEVELOPMENT.

In his address before the Chicago Electric Club on "Coming Development of Electric Railways," Lieut. F. J. Sprague, one of our ablest authorities on rapid transit, and an electrical engineer of recognized ability, says that within a year there will be in operation in this country five electric locomotives of from 700 to 1,200 horse-power, and weighing from 45 to 80 tons. Such machines will haul trains of 450 tons at 30 miles per hour up a grade of 26 feet to the mile. They will be high speed locomotives operating at a potential about double that now used in electric railway work. The author is of the opinion that such a service as might be furnished by two-car trains running at 10 minute intervals, would give the best results on a high speed and long distance line, as, for example, a line between New York and Philadelphia. The suburban service of the Illinois Central Railway, at Chicago, is regarded by Mr. Sprague as an ideal opportunity for an electrical rapid transit installation.

ELECTRICAL PURIFICATION OF SEWAGE.

Dr. C. A. Burghardt recently read before an English engineering society a paper on sewage and its purification. Among other processes is mentioned an electrical process. Iron is the active agent and is derived from iron plates placed in cells through which the sewage constantly flows. One set of cells is positive and the other negative. Only the positive plate is acted upon and dissolved upon its surface, hydrated ferrous oxide being produced by the action of the nascent oxygen (liberated by the decomposition of the water at this pole) acting upon the metallic iron. This hydrated ferrous oxide (which is in solution) then acts upon the organic matter, becoming, first, hydrated ferric oxide by absorption of oxygen from the air, giving up this oxygen again to the organic matter and becoming the lower oxide, and repeating this operation for a considerable time until the carbonaceous matters which are oxidizable have been oxidized, when no further reduction of the ferric hydrate can take place and it remains insoluble and suspended in the effluent, as a yellowish precipitate. In order to cause the plates to wear off or dissolve equally, the poles are reversed on alternate days, a plate being positive one day and negative on another day.

The electrical process has been submitted to a thorough trial at Weaste from October, 1891, to March, 1892, on a specified quantity of 4,167 gallons per hour, or 100,000 gallons per 24 hours. The current density employed was one ampere for every seven square feet of electrode surface, or 0.4 ampere hour per gallon of treated sewage. The electric shoots or channels were constructed in four lengths—the smallest number which would be adopted in practice. Each of the four shoots is divided into 34 cells, each cell containing 16 iron plates each two feet by one foot six inches by one-half inch. The total weight of iron plates employed in this trial was about 55 tons. The plates were connected all parallel in each cell, the cells in each shoot connected in series and the four shoots parallel. The electrical energy employed was 50 amperes at a pressure of 50 volts, or a little over four induced horse-power. Each of the shoots was connected by conductors with a distribution board and suitable switches in the engine house, in order to enable the operator to reverse the current of any one shoot when desirable. This reversal of the current was carried out upon one shoot at a time, the other three shoots taking temporarily the whole flow of the sewage. The poles of the shoot in question being reversed, the cells in that shoot were short-circuited, which at once caused a very rapid discharge of the back current. After this had taken place the current was reapplied in the opposite direction through a resistance coil, and the resistance gradually cut out as the normal electrical conditions were established. The treated sewage then flows into ten setting tanks (two sets of five), each tank being eight feet wide, 16 feet long, and about 5 feet deep. The sewage flowed continuously through one or other of the sets of five tanks, and over the intermediate walls of each tank, which were provided with double lips in order to assist the oxidation of the effluent. It was found that the production of wet sludge was at the rate of 17.5 tons per million gallons of sewage treated. The suspended matter is principally hydrated ferric oxide, and practically free from organic matter of an objectionable character. The amount of metallic iron used is about three grains per gallon of treated sewage, and nearly all this is present in the sludge as hydrated ferric oxide. Experiments were carried out with this sludge, by burning it under proper conditions, when it was found that a red oxide of iron was obtained which could be converted into a pigment. Possibly this pigment may be so produced in a satisfactory condition and disposed of at a price which will cover the cost of production; and thus get rid of the sludge. The suspended matter was removed by passing the settled effluent over ordinary sand filter-beds, and it was found that the filters did not become choked at all, but retained their efficiency from October, 1891, to the end of the trial in March, 1892.

Doubtless there is a future before this process, and American engineers would do well to investigate it thoroughly. It seems to leave little to be desired, regarded from a scientific point of view.

PERSONAL.

Captain Wm. Brophy, of Boston, was in New York last week.

Mr. Frank Harrington has returned to New York from the Pacific Coast.

Mr. Elias E. Ries, president and general manager of the Ries Electric Specialty Company, Baltimore, Md., was a recent New York visitor, and made the ELECTRICAL REVIEW a pleasant call.

Mr. W. S. Hine severed his connection with the Westinghouse Company on August 1. He will immediately begin the rehearsal of his new opera, "The Fencing Master," in which he will appear in New York next autumn.

The Hon. Henry Howard has resigned as president and director in the Providence Telephone Company. Henry C. Cranston has been elected president and A. O. Morgan becomes vice-president in the place of William Cranston. Col. S. P. Colt has been elected to fill the vacancy in the board of directors.

Mr. Geo. F. Porter, secretary of the National Electric Light Association, is visiting Chicago, Cleveland and Detroit in the interests of the Association. In Chicago he met Mr. C. O. Baker, Jr., master of transportation for the Association, and these two gentlemen will be traveling companions for a few days, working together in behalf of the Association.

Mr. Chas. O'C. Hennessy, of the *Daily News*, sailed for England Saturday last, a party of newspaper friends chartering a boat and accompanying him down the Bay. Mr. Hennessy will be remembered by electrical people as the first man to be indicted for publishing the news of electrical execution. A more popular member of the newspaper profession does not live in New York than this brainy young editor.

Mr. John M. Orford, who, for the past eight years, has been superintendent of the Bridgeport, Conn., Electric Light Company, has resigned that position, and on September 1 will engage in business for himself at Boston as an electrical engineer. He will probably associate others with him and form a stock company. Previous to his departure a number of Mr. Orford's friends tendered to him a supper and testimonial at the Gaillard Café, Bridgeport.

Dr. S. S. Wheeler, president of the Crocker-Wheeler Electric Company, sailed August 3 on the "Germanic" for a much needed vacation. He has taken with him letters of introduction to the principal electrical men in Europe, and will consult with them upon matters of interest to the electrical profession. He will visit the principal central stations to gather from their experience anything that may benefit the interests of the company of which he is president.

Prof. F. B. Crocker, vice-president of the Crocker-Wheeler Electric Company, arrived on the "Teutonic" August 3, after a six weeks' sojourn abroad. He has seen in this short time nearly every electrical engineer of note, has visited the principal central stations and works of Europe, and has taken a general survey of the electrical field. He says that one of the principal motor manufacturers told him with a great deal of pride that they had made as many as 200 small motors.

Kerite Cables.

The New York Central & Hudson River Railroad has recently placed an order with W. R. Brixey, general manager for S. A. Day, for 300 miles of Kerite aerial cable. The cable is to be used in operating the most complete block signaling system in the world. It will be run between New York and Buffalo, and carries eight conductors. The cable is now being turned out at the Kerite factory at Seymour, Conn. This contract is said to be the largest of its kind ever let in this country.

A new Kerite 18 conductor submarine cable was laid in the North river, from Barclay street, New York, to Morgan street, Jersey City, last Thursday. It was installed for the Metropolitan Telephone & Telegraph Company, and is 5,300 feet long. This is the seventh Kerite submarine cable laid for the telephone company during the past year.

New Instantaneous Switches.

The need of an effective instantaneous switch for use on railway and high tension circuits, and one which can be relied upon to respond immediately to the desire of the station operator and break the circuit instantly, while avoiding the dangerous and costly arc, has been long felt in all the numerous stations in this country. Many

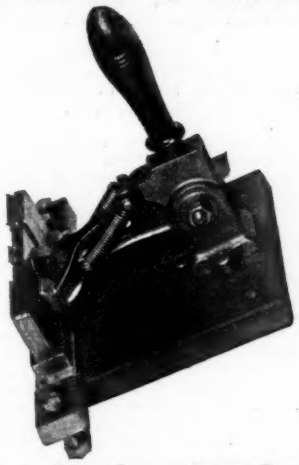


FIG. 1.—SMALL INSTANTANEOUS SWITCH.

expedients have been tried, and numbers of different types of switches have, more or less speedily, found their way to the scrap heap. But these transitory and experimental devices have served to crystallize the idea of what a perfect snap-switch should be, and its functions to fulfill the requirements of the station.

The cross-bar instantaneous switch, the invention of the General Electric Company, is the latest high voltage instantaneous switch and appears to be one of the most perfect snap-switches yet devised. As its name indicates, it is a switch having its contact blade at right angles to the actuating lever. The terminal clips are placed opposite each other, but widely separated, and the circuit is made as soon as the cross-bar simultaneously enters both clips. This cross-bar is loosely supported in the paws of the lever by two steel pins, and a small steel spring serves to press the bar against the lever so that it will enter the clips truly, and make full and easy contact with both inside faces of the clips. Practical use has shown that this flexible method of mounting the cross-bar increases the durability of the switch, the alignment of the parts being rendered less liable to destruction by violent or careless handling. The snap, or instantaneous, action of the switch is obtained by means of two strong spiral springs which are attached both to the handle and the lever. The movement downward of the handle distends the springs to that point of tension which compels the obedience of the lever, and the cross-bar flies out from the clips, breaking the circuit at two points, and reducing the possibility of arcing to a minimum. When the switch is fully opened, a catch spring retains it in position, and an accidental closing of the circuit is rendered impossible; this small spring also serves to give a snap action to the switch when the circuit is made.

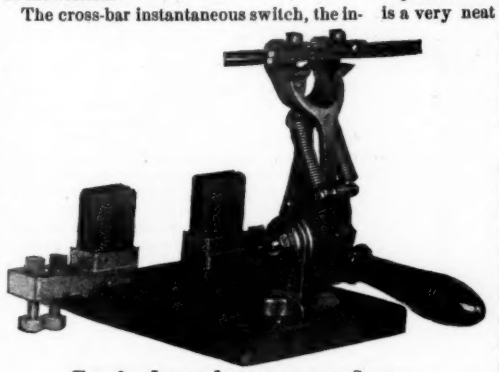


FIG. 2.—LARGE INSTANTANEOUS SWITCH.

The principal novel points in this switch are claimed to be: Considerable distance between the clips; an absolutely instantaneous breaking of the circuit and a perfect flexible and frictional contact. The smaller sizes have the cross-bar in a single piece, those of larger capacity are provided with a double parallel bar, as shown in the cut.

The American Chemical Society.

The fifth general meeting will open at Rochester, N. Y., at 11 A. M., August 16. The first session will be devoted to the reading of papers, the second, August 17, to reading of papers and general business. The committee on revision of the constitution will meet at 3 P. M., Tuesday.

A paper upon the life and scientific services of Prof. Jean Servais Stas, by Prof. Edward W. Morley, will be presented.

Members are requested to send the titles of papers to be read to A. A. Breneman, chairman committee of arrangements, 97 Water street, New York, without delay. All papers must be presented to the committee before they can be read at the meeting.

All chemists, and all persons interested in the progress of chemistry, are cordially invited to attend the meeting.

Railroad and hotel rates can be ascertained by writing to H. L. Fairchild, Secretary Local Committee, A. A. A. S., Rochester, N. Y.

Members of the American Chemical Society and others attending this meeting are entitled to all the facilities offered at the meeting of the American Association for the Advancement of Science, which is held at the same time.

The "Gem" Speed Alarm Indicator.

The illustration presented herewith shows one of the neatest and most useful pocket tools for electricians and others that has been lately put on the market. The "Gem" double speed alarm bell indicator implies, in the name, about all there is to be said to explain the character of this invention. It is a very neat combination of a speed indicator and alarm bell. It is nickel plated, and in size is only $3\frac{5}{8}$x$1\frac{1}{2}$x$\frac{7}{8}$ inches, and may be easily carried in the vest pocket.

To use the "Gem" indicator, apply the engaging point to the shaft of the machine being tested and, with watch in hand, wait until the bell rings. Upon the ringing of the bell begin to observe the time and continue as long as may be desired, it being simply necessary to count the strokes of the bell thereafter, each stroke indicating 100 revolutions. Upon expiration of time limit remove the indicator and add any fraction of 100 that may be shown upon the dial to the full hundreds previously counted by bell strokes.

THE "GEM" SPEED ALARM INDICATOR.

The handiness of this instrument will be readily appreciated by engineers, lathemen, dynamo tenders, and those who have to do with machinery and engines of all kinds. Every owner of an electric fan should have one of these devices to test the work that his motor may be doing. The E. S. Greeley & Company, 5 and 7 Dey street, New York, who are placing these goods on the market, anticipate a very large sale for them.

LETTERS FROM A LABORATORY.—VII.

BY JULIAN A. MOSES.

You have something that has been broken; suppose it to be of metal and that it will not stand heating. It is essential that the pieces be held together by some mechanical contrivance, or that they be soldered. What can we do if the article may not be heated? What is known as cold soldering comes to our aid. The objects to be joined are first tinned with the mixture above mentioned, and then some dental copper amalgam, that has been previously heated, is laid between the pieces. They must be pressed together and held with a clamp or piece of string until the amalgam has set, which will be in about three or four hours. This amalgam sets very hard, and if the pieces have been well tinned a firm joint will result.

"Our goods have become shop-worn; the iron on our samples is rusty; the steel springs will oxidize." These and like expressions we hear every day. Is it because we are careless, or is it because we do not know of "an ounce of prevention?" There are many anti-rust substances, but among the many that I have seen there has been but one or two that, after being applied to the iron object, would enable you to touch it (the object) without rusting it. The main difficulty with these processes is that the article to be coated had to be submitted to a rather high degree of heat, it being necessary for steam to be decomposed in order to coat the iron with the black magnetic oxide. Naturally this was only applicable to those tools that would withstand heat. Any substance that will not affect iron, that is air and water-proof, that will stick to polished steel or iron, and that can be easily applied and as easily removed, will be satisfactory as an "anti-rust."

Collodion possesses these properties, and it is this material which I would advise those who have any iron or steel instruments to protect from the ravages of salt air or moisture to make use of. Its manner of application is simple. The article to be coated need only be painted with or dipped in the liquid collodion, which should be rather fluid. To remove it when necessary, rub with a rag dipped in a mixture of ether and alcohol. As this mixture is the solvent of collodion, it may be used for thinning the solution. Collodion is made by dissolving pyroxiline in a mixture of alcohol one part and ether two parts. This process coats the object with a thin but tough skin, which is an excellent preventive of rust.

There is nothing better to remove grease spots from clothing, etc., than ether. Wet some absorbent cotton, *away from a flame*, with the ether, and rub briskly over the grease spot. This process is almost infallible, and it seems strange that it is not more commonly employed. Many small bills from the tailor would be saved by its use. The ether should be kept in a tightly closed bottle, away from any possible flame. To remove oil or grease from the inside of a bottle: After shaking with small shot and soap and rinsing out, wash with strong sulphuric acid, being careful not to pour any water into the vessel while it contains the acid. Pour out the acid and wash well, at least three times, with water. It would be advisable at this point to caution you about the use of sulphuric acid and water. *Always pour the acid into the water; never pour the water into the acid.* While mixing the acid with the water the temperature of the liquid rises to about 300 degrees F., and, unless the above caution is carefully followed, bubbles of steam are likely to be formed, which, exploding, are liable to project some of the sulphuric acid into your face.

To clean brass, I find, where it has become oxidized, the best thing to remove the coating is the celebrated "Putz Pomade." If you wish to lacquer the brass afterwards rub it with "Vienna Lime," which will absorb all the grease, and permit the lacquer to adhere at every point.

A New Catalogue.

The Bryant Electric Company, of Bridgeport, Conn., is sending out a very pretty catalogue describing their electrical specialties for incandescent lighting. It is from the press of Bartlett & Company, New York.

Coming Development of Electric Railways.

READ BEFORE THE CHICAGO ELECTRIC CLUB BY LIEUT. F. J. SPRAGUE.

It is a trite but mistaken saying that electricity is in its infancy. It dropped its swaddling clothes when Morse sent the first telegraphic message. It put aside dresses and pinafores when the dynamo machine and arc light were invented. The incandescent lamp, the telephone, the art of welding, the transformer are incidents of buoyant youth. The modern electric motor and electric railway mark a vigorous manhood.

The truly marvelous development of electric applications of every kind, the accomplishment of many things, which in ignorance of the very art or lack of knowledge of what are now well known facts, and, more particularly, the great commercial development of the transmission of power, whether for stationary purposes or for electric railways, has led to many a foolish prediction and idle boast.

This is no age of inspiration nor time for hopes never to attain fruition. It is, above all things, a practical age, perhaps too practical, but, nevertheless, one in which commercial enterprises, to be successful, must promise either a new field of development or economies in older fields.

As the orthodox few have been waiting in sublime faith for many centuries, and will wait for many more, for the fulfillment of ancient prophecies, so too will impracticable electric enthusiasts vainly wait for the millenium when investments are boundless, performances limitless and efficiencies unity.

It would, perhaps, have been proper in making my inaugural address to so representative a body as that of the Electrical Engineers that I should touch upon the special discoveries and experiments which have recently attracted attention, but there have been so many enthusiastic and brilliant workers that neither the time at my disposal nor the knowledge I possess would permit me to do justice to their work; hence, it seems better to take up a subject with which I have been more particularly identified, which to-day commands so much attention, and concerning which there are such conflicting opinions. While finding encouragement in the past achievement of our profession, I think the time opportune for a word of caution.

Electric street railways are no longer experimental nor is their success problematical. Their history for the past five years is that of an almost unequalled development. Almost within a decade has occurred the first working of a practical electric railway. In a third of that period there have been put in operation, or are under contract, more than 450 roads, equipped with nearly 6,000 cars and over 10,000 motors, and with over 3,000 miles of track. There is made a daily mileage of not less than 700,000 miles, and over a billion of passengers are carried annually. At least $75,000,000 have been invested in this industry alone; 30,000 horses in a single year have been relieved from the slavery of street car propulsion; stables are disappearing and streets becoming cleaner; luxurious cars are running on smooth, well-built and rigid road-beds. Dividends have been increased, expenses reduced, investments enlarged, the unproductive have become productive, the impossible possible. Land values have been increased, habital limits extended, homes created and time saved.

We no longer hear seriously of the dangers of the trolley wire, the failure of service. The time has come when legitimate investment is amply warranted. Electric street railway construction has become a matter of engineering, not experiment. Not only have the smaller towns adopted what is the only available means of current supply, but the larger cities are following their example. St. Louis and Baltimore, Minneapolis and St. Paul, Buffalo and Rochester, Boston and Brooklyn, have fallen into line, and latterly even Philadelphia seeks an improved street service, and in New York public interest is being aroused.

In the latter city it is, of course, impossible to tell how successful will be the attempt to introduce electric propulsion. There is there a strong and in many respects a legitimate objection to overhead wires. Many unsightly poles and badly strung wires have disappeared, and their place been taken by an underground service.

The general feeling of opposition to poles and wires ought not, however, to act as a barrier to such reasonable and proper introduction of an overhead system of supply, as the conditions now existing in that city very properly warrant. I have frequently pointed out the fact that the greatest good can come of the greatest number, especially in the over-burdened condition of transit which there exists, if certain of the lines were electrically equipped; wherever, in fact, there would be no street obstruction.

In broad streets, where the tracks occupy only a small portion of the street and are near together, a line of poles of ornate design, with arms projecting on either side, can follow the center of the street, the same poles being used for lighting. Such a street, it seems to me, is Eighth Avenue; then, too, where there is a middle division or park, such as exists in many boulevards, and which is now used for telegraph poles, there is opportunity for an electric construction which would be entirely unobjectionable.

On streets occupied with elevated structures, these structures themselves would be used for a practically rigid overhead system.

Among the numerous places in New York where an overhead system could be put in perfect operation are Central Park, West, the Boulevard from 59th street up; a part of the First and Second Avenue Lines; the Third, Sixth and Ninth Avenue Lines, and all the suburban extensions from the annexed district.

I am not sufficiently familiar with the streets of Chicago, which is the last other remaining city which must consider electric street railways.

In these larger cities, however, one condition should be insisted upon, and if this condition is met in the proper spirit, then much of the objection which has been raised against an overhead system must necessarily disappear.

The construction must be of the very best. The only overhead line allowed should be a contact wire with sufficient strength, the main conductors and the feeders should be put underground in proper conduits. There would then be overhead only a wire necessary for the smallest duty and of the requisite strength. In many streets, of course, the cable will hold its own until an electric conduit or surface contact system shall be proven satisfactory.

Impressed by the great development of this industry, and brought face to face with the changes it has wrought, the query is continually made, Will the electric motor replace the steam locomotive? It is similar to the older questions, Will the telephone replace the telegraph? Will the electric light annihilate the gas system? And in all soberness a like answer can be made, it will not; but it will, as the electric light and as the telephone have done, create a field of its own, and will replace a portion of the service now done by steam.

It seems to me that the growth of electric railways will proceed something in this order: First, the street systems in the various towns, then connecting lines between adjacent towns following the lines of highways, then longer connecting lines, either on the tracks of existing steam lines, or, growing bolder, on exclusive rights of way on the same order. Then will come suburban traffic on a larger scale, and freight transfer systems, and, finally, the more ambitious projects of trunk line service under limiting conditions, such as I will specify.

It has been very properly said that a man will make the first long rides on electric railways by transferring from one town system to another through connecting links, rather than on individual roads.

This is precisely the process by which great systems have been built up, although, of course, starting on a larger scale, and it is but natural that this shall be one step in the development of electric railways.

But evidently this natural process of evolution does not offer scope enough for the more enthusiastic, and we are now and again treated to an ideal electric road, to be built on plans boldly defying both geography and the abodes of civilization.

An air line route according to rules of surveying allowed only in Russia and on the Desert of Sahara; abolition of grades and street crossings; rigid and continuous rails; loaded cars of light weight, each operated by its own motor and making few or no stops; unlimited potentials and undiscovered resistance to insulation; new physiological and engineering laws; indestructible machinery; unheard of powers of braking and new methods of train operation and signaling; around all a clear atmosphere; above all a perpetually smiling heaven, and behind all an unlimited bank account and the unlimited confidence of the investor.

Such are some of the characteristics of such a road, but perhaps it is but fair to ask, given some of these conditions, what would be the capacity of steam traction?

No one will question the capacity of a motor to do the necessary work required, or to make a speed superior to that of the steam locomotive, provided sufficient energy be delivered to its terminals, but we must deal with existing or probable methods of supply. It is true that the speed at which a train is propelled by steam has only increased about 50 per cent. in 60 years, for in 1832 the "Matthew Baldwin" often made a speed of a mile in a minute; but we must not confound speed with power, for while the maximum speed has not been so materially increased, the endurance, the perfection of the mechanism, and the economy of performance have made great strides, and the increased speed, which is by no means the maximum possible of a locomotive *per se*, has been attained at much higher powers, and the schedule time has been shortened principally by cutting down grades, straightening curves, filling up ravines, abolishing trestle works, replacing wood bridges by permanent ones of iron or stone; by the use of heavier and stiffer rails, better switches, improved methods of automatic signaling, the interlocking switch and signal system, and the abolition of grade crossings; in short, by improvements in details and management which permit of higher speeds on more extended sections of road, because of greater safety, lower traction coefficients, and a greater degree of confidence possessed by the engine.

All these things are necessary for high speed electric railways, and any general improvements that will be of benefit to the latter must necessarily be of service to the former.

Now, any predictions which are made concerning the future of electric propulsions, either in ignorance or disregard of the possibilities of steam duty, and the limitations necessarily existing in all systems of transportation, deserve and will receive little consideration.

Hence, let us note a few of recent locomotive performances.

Almost every one is familiar with the remarkable run recently made by a Schenectady locomotive hauling a special train on the New York Central Railroad, when the distance of 439½ miles from New York to Buffalo was made at an average speed of nearly 60 miles per hour, and which was the precursor of the Empire State Express, which makes the regular run at an average speed of over 52 miles.

More recently, we have accounts of an interesting record made by a well-known writer on two runs between New York and Albany, on which a large number of indicator cards were taken. The weight of train was about 270 tons. The steam pressure varied from 160 to 170 pounds. From an inspection of about a dozen cards, the indicated horse-power varied from 551 horse-power at 44 miles to 1,120 horse-power at 78.9 miles.

At 60 miles per hour the train resistance is stated to have been 15 pounds per ton, and at 70 miles, 17.10 pounds per ton.

About seven pounds of water were evaporated per pound of coal.

A remarkable statement concerning this performance was made by Mr. Sinclair, which, while almost incredible, will, if borne out by an analysis of facts, prove to be something of a surprise to those who make their prophecies of the electric economies by comparative statements.

In the description of these tests in a recent number of *Locomotive Engineering*, it is stated that the whole trip shows an indicated horse-power per hour for an average expenditure of only about 3⅛ pounds of coal per hour.

This is far better than many stationary engines.

On the New Jersey Central Road one schedule time is 86¼ miles in 89 minutes, which is made where there are a number of necessary slackings. On the 13th of May the time was taken of this speed of a Baldwin compound locomotive for a considerable period of time on one of the regular runs. Ten continuous miles were made in 452½ seconds and five were made in 222 seconds. The fastest time taken was 44 seconds, and the slowest noted was 47.

On the 26th of last February a similar compound passenger locomotive running on the same road broke all steam records by running a mile in 39¼ seconds, or at the rate of nearly 92 miles per hour.

At this speed the indicator cards showed 930 horse-power, and the drivers, which are 78 inches in diameter, were making 395 revolutions per minute.

In the very near future I expect to have the pleasure of riding on a locomotive when going on these high speeds, and I presume my respect for steam locomotion will not be diminished thereby, nor, on the other hand, will my confidence in the possibilities of electric propulsion under the proper conditions.

Experimental runs have been made with an electric locomotive at the rate of one mile in 30 seconds; that is 120 miles an hour, and I confidently expect some day to go at that rate. But it will be under special conditions and not on the regular trunk lines of this country, and it is the height of folly to suggest that these steam trunk lines are to be abolished.

In making these very high speed runs there is not much attempt at maximum economy or coal consumption, the necessity being to generate steam as fast as required by the cylinders; but on taking an average of five trips I find that there was evaporated 7.19 pounds of water per pound of coal used, and 9.41 pounds of water evaporated per pound of coal consumed. The total weight of train varied from 213 to 241 tons.

The personal equations of engineer and fireman necessarily enter seriously into steam operations, and this, compounded of course with the peculiarities of each engine and the conditions of service, is shown in railroad reports.

In this connection, I recently inspected a number of engine sheets. On one, which gave the duties of 25 engines, the average total cost per engine mile was 10.85 cents, of which 2.66 was for fuel. The total cost varied from 6.8 to 19.24 cents, and the fuel (wood) from 1.96 to 4.77 cents.

On another sheet giving the performance of 22 engines, the total cost per engine mile was 14.70 cents, of which the fuel cost 4.61. The total cost varied from 8.82 to 27.98 cents, and the fuel cost from 2.04 to 7.48.

In still another, that of the performance of 18 engines, the total cost per engine mile was 14.73 cents, of which the fuel (coal) cost 6.62 cents. The total cost varied from 10.04 to 22.52 cents, and the fuel cost from 3.82 to 13.84 cents.

In discussing the electric system there is often a confusion of statements with reference to economy. Despite the undoubted fact that the electric motor can probably be run at variable high speeds with less variation of economy than can the steam locomotive, we must not forget that in the latter we are considering the economy of the unit as a whole, not merely of the steam cylinders but also of the boiler and the furnace.

In electric propulsion a similar comparison of economies must take into account the variable duty of the central station and the losses on the line as well as those in the motor, and where single units are used the variation in economy of the whole system would be much greater than in the steam locomotive. There will be only a reasonable fixed efficiency of the central station and the line when the number of units is large enough to make the load on the central stations nearly constant.

Let us now consider another class of duty.

Some time ago I made a very careful analysis of the work done on the elevated roads in New York city with a view of determining the coal consumption and the duty performed by the locomotives. At the time this investigation was made, now nearly seven years ago, there were in use on the Third avenue division 63 trains at one time, running at very close intervals. The weight of the trains was from 80 to 90 tons; the speed was often as high as 20 to 25 miles an hour; stops were made every third of a mile; in short, the duty demanded of the engines was exceedingly severe.

The maximum indicated horse-power of the locomotives was found to average about 163 horse-power, although on occasions these locomotives have been worked up to 185 horse-power. Work was divided approximately as follows:

Acceleration in starting, 59 per cent., lifting, 24.3 per cent., and traction, 16.7 per cent. The average horse-power exerted was 70.3 horse-power, considerably less than one-half of the maximum.

The work on the line was so distributed that there was an almost constant total duty of about 4,500 horse-power. The locomotives were on duty 20 hours, but used steam only six hours, and, including all losses when standing still and the amount of steam used in braking, there was a horse-power developed for about 6.2 pounds of coal.

I believe that these figures are entirely reliable, and they show a remarkable performance when we consider the class of duty.

An analysis of the coal expenditures showed that with an efficiency of 60 per cent. and without any of the energy of the train being returned to the line, the relative coal expenditures between steam and electricity would be about in a ratio of 2 to 1, but if the energy of the train was returned to the line to the extent which I believe it is possible, then the relative expenditures of fuel would be in the proportion of 7 to 2. Since the coal charge on the four divisions was at that time about $550,000, it can easily be seen that, independent of any question of saving in the care of the structure and any reduction or depreciation of the motor equipment, the fuel saving would be sufficient to pay a good interest on the cost of an electric equipment, and a large interest on the cost of electric equipment minus this value of the present engines.

I have no reason to doubt the soundness of the conclusions I then made.

You will have here in Chicago, however, a somewhat more advanced condition of affairs. A compound type of locomotive has been adopted for the elevated road service, and I believe it will show an increased economy over that of the operation of the New York roads. Consequently, in discussing the question of economy, it is necessary to get full information concerning the duty which will be done here.

In discussing high speed possibilities and limitations, the testimony of Dr. Dudley, as given in a discussion of a paper before this Institute, on the 24th of February, 1891, is interesting.

There are, generally speaking, three distinct elements constituting the resistance to train movement on a level, and they have a most important bearing, when we consider the operation of long or short trains and at high speeds. One of these elements is the ruling friction of the train in its bearings. With good rolling stock this is about eight pounds per ton. For all reasonable speeds it is probably fairly constant, provided the lubrication is good. Another element is that

of air resistance, which varies with the shape of the forward end of the train, the condition of the air, the direction of the wind, and the velocity of movement. The third, I may call the train lifting or rail bending effort, which depends upon the weight and swiftness of the rails and solidity of the roadbed.

Dr. Dudley stated that on the New York Central system he found that trains of about 250 tons, when running at a speed of a mile a minute, have a resistance of from 10 to 12 pounds per ton, but that on short trains of two or three cars the resistance sometimes ran as high as 35 or 40 pounds per ton.

This is probably due, not to any change in the friction of the bearings, but to the fact that the air resistance enters as a much higher component of the total.

It at once emphasizes the fact that the operation of short trains at high speeds must, no matter how good the track or how favorable all other circumstances, be with a train resistance higher than that required by long and well vestibuled trains.

Such a shape can be given to the front of an electric locomotive as will make the air resistance not over one-half that presented by a plain surface of equal cross-section and perpendicular to the line of motion, but even this fact does not alter the other, that the resistance per ton must be higher for small trains than for large ones.

Mr. Dudley further stated, in speaking of the influence of stiff rails, that the difference in power required on the Chicago Limited when running on an 80 and a 65 pound rail was from 75 to 100 horse-power per mile, that is, somewhere between 10 to 12 per cent. of the power actually developed, and he estimates that with a 105 pound rail, which is nearly twice as stiff as the 80 pound rail, there would probably be saved another hundred horse-power per mile, making a total saving of a quarter by less than doubling the weight of the rail. In his opinion it is perfectly safe to run a steam engine 120 miles an hour on this heavy rail.

Such rail improvements increase speed possibilities with present engines, but we have not related the limit of steam duty.

Almost all the locomotive work of the United States has been done up to the present with simple engines. Their weight and capacity has been increased, their steam pressure raised until the standard is now about 140 pounds. Within recent years, however, the compound locomotive has come into use, and there is a comparatively large number of them in daily service. The steam pressure has gone up to 180 pounds as a standard, working sometimes as high as 200 pounds, but these are by no means the limits of steam pressure.

On the Paris, Lyons and Mediterranean Railway the standard for steam pressure is for compound locomotives 250 pounds. The compound locomotive has still its battle to fight, but I think it would be a rash man who will say that the days of still higher steam pressure are not to come, and that the triple expansion locomotive will never exist.

Speed, capacity and coal economy are, however, not the only questions to be considered in railroad operation, and in discussing the general subject it will be found that the signaling and braking questions at high speeds are serious ones. Undoubtedly, an electric train with distributed motors, making the weight of the train available for traction, could, by using the motors as dynamos to return the energy of the train to the line from the highest to mean speeds, and then on a local circuit, be more quickly and effectually slowed down and stopped than where shoe brakes are used, and both methods of course, would be available.

But, if using a motor ahead of a train, then there will be comparatively little difference in the stopping power.

When riding at 60 or 70 miles an hour, it is a very quick stop to bring a train at rest in less than 2,000 feet. This is often as far as any signal can be made out, especially when the weather is at all thick. Hence, we may expect to find on electric railroads if high speeds are to be attained, and quite possibly also on steam railroads, an extension of automatic signaling, so that trains indicate on more than two sets of signals. At present the practice is to divide the line into sections, and when a train passes a certain point it sets a danger and a cautionary signal, dropping the danger signal on the section just preceding and the cautionary signal on the one beyond.

Turning, now, to the greater powers, we must not confuse the terms "large powered" and "trunk line" work.

There are two statements which I think will need no corroboration.

If we had a continuous train movement completely occupying a trunk system, there can be no question but that its operation from a central source by electricity would be more economical than if operated by steam locomotives.

So, too, if a large number of units in reasonable proximity are moved, and the stopping and starting so regulated that the total demand upon the central stations is fairly continuous and equal, then there is no reason as to economy of electric propulsion as compared with steam.

On the other hand, the operation of a single or very few units over a long distance would be so uneconomical and afford so small a return on the investment required as to make it prohibitory.

Between these two lies the condition of operation where steam and electricity meet on planes of equality; as the number of trains decreases, steam operation is the more economical; as the number increases, electricity must be preferred.

In discussing the use of electricity instead of steam, a well known steam engineer recently stated that in his judgment it must be conceded that electromotive force for the propulsion of cars will not be economical, except for suburban traffic and upon certain sections of important trunk lines like New York Central between New York and Albany, the Pennsylvania system between New York and Philadelphia, and other lines of like character where it is necessary to disband a large number of comparatively light trains every day, and at short intervals. The principal field for a power of this kind would be in suburban service long enough to make the ordinary street electric cars unpopular because of the time required, and in such cases as those mentioned above, also for moving freight trains in city; that is, for the performance of transfer service.

This is precisely in line with the arguments which I have advanced from time to time, and which I illustrated in a paper before the National Electric Light Association at its convention in Kansas City, where I outlined the possible service between New York and Philadelphia, which I believed to be practicable, and to which I will again refer.

I must repeat that it narrows itself down to the one question as to the number of trains operated between two terminal points. Make that number of trains sufficiently large and the electric motor is the best means of propulsion, whether for high or low speed, whether for large or for small cars. Decrease this number and we must rely on steam propulsion, or, to put it in another way, the answer to the query, Will electricity take the place of steam for railroad purposes? is: Only in part, and then only when the number of units operated between the terminal points is so large that the fuel economy would pay a reasonable interest and depreciation of the necessary cost of the central station and the system of conductors.

Of course, I do not in this general reply consider those special cases where advantages are to be gained, for which there is a return for capital in another direction. Such a case is that of the Baltimore Tunnel, where the investment and cost of operation will be greater than that for steam propulsion; in fact, there will practically be no economy in power, because the steam locomotives are not done away with, but simply unused for a period of a little over a mile. There is in this specific case, however, the incidental advantage of doing away with the necessity of a ventilating plant, and yet getting rid of the annoyances incidental to tunnel service.

Trunk line transportation being a great problem, we should not attempt the simultaneous solutions of all the questions involved, but, instead, determine what those questions are, consider their sequence, and the probability of success, and solve them in their order.

Every system has its limitation. The electric is not exempt from this law, and hence, it will set forth what are well known limiting laws concerning the transmission of energy. They have been stated time and again, but somehow or another people often lose sight of them in discussing the question of investments in large electric railways, so that I think it would be well, perhaps, to re-state and emphasize them.

The weight of copper necessary to transmit a given amount of power with a fixed loss will vary inversely as the square of the electromotive force used.

The distance to which it can be transmitted with a given weight of conductor will vary directly as the pressure.

The distance to which it can be transmitted over a conductor with a given cross section will vary directly as the pressure.

The weight of copper necessary where the supply station is in the center of a system is only one-quarter that required if the station is at one end.

The weight of copper will vary inversely as the square of the number of supplying stations properly placed.

The electromotive force required will vary inversely as the number of stations.

Lack of knowledge of these simplex and inalterable laws have led to much misconception of electrical possibilities, and these have not been confined to the electrical engineers.

In many of the suggestions which have been made, even by practical steam engineers, there has been an unnecessary confusion of impracticable and practicable, and the specific object which should have been borne in mind has been lost sight of.

Committees have drawn impossible specifications for trunk line service, and demanded of electric motors a capacity and performance superior to that of the best compound steam locomotives. I unhesitatingly pronounce any attempt to build some such machines for the present certainly unnecessary and impracticable. The service thus suggested, if at all needed, will for many years be better performed by the steam locomotive than the electric.

Leaving out of present consideration trunk line work, there are three problems requiring solution in the application of electricity to propulsion on a large scale under conditions existing, for example, in Chicago or in any other place where there is a movement of a large number of trains on more or less complicated tracks, as will be found at almost all terminal railway stations. They are:

1. The development of an electric locomotive of ample power, which shall be as readily controlled as the steam locomotive, shall be reliable in operation, and shall show a high economy.

Of course, such a machine must have all the adjuncts which are necessary for train movement.

2. A system of conductors and methods of supporting the same which can be relied upon for ample supply of current and absolute certainty of continuous contact at all speeds on curves, switches, cross overs and the multitudinous combinations which exist on yard tracks.

3. A system of automatic block signaling, which while effective for steam traffic will not be thrown out of operation by the use of tracks as conductors of electricity for a general supply. This is a more serious question than is at first considered, for this use will materially interfere with, if not absolutely destroy, the utility of what is known as the rail circuit system.

This third problem is one which must necessarily follow the development of the other two, as the automatic signaling systems now existing have followed the development of steam practice.

While I am not by any means thoroughly familiar with the various methods of automatic signaling, I believe I am justified in saying that there is none at present existing which will meet all the requirements of railway practice, and which can be operated on tracks used by both steam and electric locomotives where the rail is used as a part of the supply circuit. Some of the best known systems of signaling would be rendered entirely inoperative.

As difficult as it may seem to devise such a system, I believe that it certainly can be developed, but only properly so on a section of track which is more or less experimental on which at the time of operation automatic signaling is unnecessary, but which is actually operated by both classes of service. Such an experimental section would be a combination of single and double tracks with all the varieties of curves, crossings, switches and ladders; such as would be found in any large yard.

It will probably be found necessary to erect a variety of kinds of conductors. From the most careful consideration which I have been able to give to the subject, I believe there is one way, and only one way, in which the current can properly be supplied in any complicated system, and that is from the overhead conductor, practically rigid in character, following very nearly the center line of all tracks and switches, with no movable overhead parts, and with return through the rail. The locomotives would then practically be moving between two electric planes, the lower being the guiding one.

I know there has been a great deal of talk about other possible systems of supply. We have heard much of the charge rail using low potential currents supplied at frequent intervals by motor generators driven from a central station.

Since we have discovered no conductors devoid of resistance, and the art of welding is not particularly applicable for railway service where moving contacts are a necessity, little credence need be given to any scheme of this character.

We heard again of the central rail supported on posts in wells between the tracks. A center rail may be acceptable on a system like that of the elevated railroads, but in ordinary railroad work, any ditch intended to drain a track so as to keep insulators dry and keep snow away from them would probably so open the track that any moisture and frost would cause upheavals of serious character, and the cost of maintaining the track would be prohibitory. The use of snow machinery for keeping the track clear would be impossible, and anything underneath the car is in the most exposed place for sustaining damage by defective rolling stock and continually liable to all sorts of mechanical injuries and accidents, with all the evil results of interruption of current, short circuiting and stoppage of traffic.

Another system which has been proposed is that of conductors supported on posts alongside of the track and elevated but three or four feet above it. While not open to so serious objections in the matter of insulation as a center rail system, its use where there are crossings or switches is manifestly not to be thought of. Even on a straight, clear track, in a hard climate, there would be most serious trouble in the matter of clearing the tracks from snow, and, if the grade crossings in this country, gaps in the conductors would be too great for the contacts on a single locomotive to stand.

Some time ago I was requested, on behalf of a well-known financial man, whose enthusiasm as to the possibilities of electric traction is well known, but who is withal a most practical railroad man, to inspect various railroad terminal tracks in this city with a view of, first, the substitution of the switching work now done by a part or all of the 1,800 or more switch engines by electric motors, and eventually the operation of suburban service.

You have before you a map showing the railroads nearly as they exist on a number of systems in Chicago in the space of about two square miles, or, more exactly, one and one-half miles in length by three-quarters of a mile in breadth. It is no exaggeration to say that there is or will be not less than 75 miles of track and switches and crossings, with their various combinations almost innumerable.

I went over and over some of these tracks with the one thought in my mind, How can the current be delivered to the locomotives, and how can the automatic signaling be done? And I was forced to the one conclusion, to which it seems every man who makes the investigation must come, and that is that the overhead system of supply is the only one, but that it must be as substantial and thorough in character as that of any other part of the system, and that, in view of the cost such a system, is only permissable where the number of units operated is large and continuous.

These conclusions are not new, but they have been emphasized by the particular problem which is here represented.

Intimately connected with the question of conductors, and one of the most serious ones which has to be met by the electrician, is that of potential. The personal danger limit of continuous or ordinary period alternate currents is pretty well determined, and it seems generally admitted by constructors that the danger limit for continuous current machine, with its commutator, is about the same as the personal danger limit.

Hence, we meet with two dilemmas. If using continuous current motors, we are limited to a difference of potential per machine of 1,000 to 1,200 volts, and we can, so far as safety of the machines is concerned, only probably go above this limit by putting the motors in series precisely as has been proposed for long distance stationary transmissions.

If this is not done, then we have the introduction between the transmitting dynamo and the receiving motor of a motor generator system, another pet theory which is often suggested, but which I unhesitatingly pronounce as so uneconomical as to be impracticable.

If using an alternate current system, then converters must be used, either distributed along the line and supplying the working circuit, or placed upon the locomotive to safeguard the motors.

While the use of a converter under these conditions is not as objectionable as the use of a motor generator, it cannot commend itself as a very practicable scheme, and certainly in view of the fact that no single phase single alternate motor promises up to the present serious success.

For the present, and I think for a long time to come, we must confine ourselves to the consideration of railroad problems where continuous currents are used, and where the traffic between two points is sufficiently large to justify the investment in central stations and conductors which would be required for the operation of such assistant.

There are two methods of propelling trains electrically; one by following steam practice; that is, by building a large motor and hooking it to the head of a train, the weight of the motor being such as is required for the necessary power and traction when grades or slippery tracks are encountered.

From all that has been developed up to the present to get the control that is necessary and to build the machines safely, the electric locomotive will weigh nearly as much per horse-power as the steam locomotive. This weight can be better distributed, but I do not think, if steam practice is followed on trunk line service, that there could be any very material reduction of weight of train.

The other plan is to have each car propelled by one or more motors. This would be the ideal system, so far as propulsion goes, provided the electric motor was unlike all other mechanical apparatus and that it never failed, and if a number of machines could be as well taken care of, cost no more and show as little depreciation as fewer machines of larger capacity operated as a unit.

Should we ever arrive, as we all hope, to the possession of a single circuit, alternate current motor, then, in view of the sim-

plicity of its control, we may fairly hope for the distributed motor system.

But here, also, the capacity and likewise the weight of the motor being determined by the total duty done, the weight of train limit would not be decreased, but rather increased.

If, on the other hand, single units are used, the query naturally arises, What form would the electric locomotive of the future take? I do not think this is by any means settled; undoubtedly, gearless machines will be used, but whether they will be mounted directly upon the axle, or whether they will movably enclose the axle and be flexibly connected to it while their weight is carried on springs on the truck, or whether the motor will be carried on the truck frame and connected to the drivers by the ordinary coupling rods, are questions which will be determined eventually by the depreciation per car mile upon the motors, trucks and road-bed, as well as by the speed to be attained.

Whatever method of mounting the motor is adopted, for reasonable weights and powers a two-axle truck will be used, but where large powers and weight are necessary, two such trucks will be coupled together so as to keep the weight upon each wheel within limits, and this will carry a cab containing the regulating and collecting devices, and so shaped as to offer the least resistance to air pressure and high speeds.

I have never advocated the use of a connecting rod in transmitting the motion from an armature to a driving axle, but I think it fair to say in this respect that the so-called hammering effect on the rails, said to take place in the ordinary locomotive driver where the weights are counter-balanced, exists more in imagination than in fact, and that the chief trouble in the use of the connecting rod is the change of direction of its movement.

Among the roads which are ripe for the electrical engineer, and on which in the near future I hope he will demonstrate he has a most legitimate claim, are the New York elevated and Chicago elevated, the handling of the trains on the New York Central and Harlem roads below the Harlem river, the long talked-of rapid transit road of New York, the Metropolitan underground road of London, the proposed tunnel roads in London, Paris and Berlin, and coming more immediately home, suburban service, such as that of the Illinois Central Railroad, a most ideal track for the electrical engineer, and last, and as it will prove one of the most important, the operation of terminal and warehouse systems for the interchange of freight on the lines entering a city situated as in Chicago.

Taking this last, we have here a definite problem, now performed in a more or less satisfactory way, by steam service. It is a problem large enough of itself. It has little connection with electric trunk line service, and the present impracticability of the latter has little bearing upon the thorough practicability of the former.

Eighteen hundred or more switch engines, many of them on duty 24 hours a day, a large portion of the time standing idle, puff their foulness into your overburdened atmosphere, because from 80 to 90 per cent. of all the freight that comes into the depots of this city ought never come inside its limits, and would not, were there a practical way provided to distribute it from one railroad to another outside the city limits. It has been suggested, and it seems to me a most feasible plan, that there shall be established a vast system for interchanging freight on the various railroads by a great six-track crossing belt road which shall form a common zone of transfer, either by itself or in combination with freight warehouses or storage yards.

Undoubtedly, there are many difficulties in the way, but from an electrical standpoint, there is absolutely no question but that such a system of belt line is practicable.

With such unsolved problems, such abundant fields, I deem it unnecessary now to attempt to build electric locomotives to pull trains of great weight 100 miles an hour, or to develop a system of conductors for trunk line service which is not possible for yard duty, or to consider a central station or track equipment for a duty never required. This problem is in a measure an experimental one, which being carried to a certain measure of success will clearly point the way for future development and outline its limits.

I may be pardoned, perhaps, if I take radical views in some matters of railroad practice. I have fortunately or otherwise been thrown into a direct touch with all the larger work which is to be done in this country during the coming year, and it gives me pleasure to announce, what many of you know from the current news of the day, that there will probably be in operation in the United States within 12 months not less than five locomotives varying from 700 to 1,200 horse-power and from 45 to 80 tons in weight. The character of the work done will vary. In that work which I am most concerned from a personal standpoint, a 700 electric locomotive will be built for experimental work, and to attempt to solve as far as may be the various problems which are involved in railroad practice in Chicago. If my judgment is followed, there will be an experimental section of track in the form of a loop about 13 miles long with 18 miles of rail, and with every variety of single and double track construction and simple and compound crossings and switches.

On this I hope to see erected such varieties of overhead construction as may be found best to meet the various kinds of service, and where the railroad problems on track jointly operated by steam and electricity can be developed in the most satisfactory manner.

On this track there will be not only this locomotive, but also one of equal rated capacity supplied by one of the larger manufacturing companies.

The duty demanded of these machines will be severe. They will be required to haul a train of not less than 450 tons at 30 miles an hour up a grade of 26 feet to a mile.

They will probably be required to develop their full rate of capacity at all speeds between 30 and 60 miles per hour, and if there is sufficient track room they will be driven at speeds of at least 75 and perhaps 100 miles per hour for short distances. The potentials used will be nearly double that at present obtaining in street railway practice.

A still larger problem, so far as power goes, although not in the variety of conditions which will have to be met, will be that recently taken for the operation of the belt line tunnel now being constructed in Baltimore to avoid the necessity of boat transfer at Locust Point. The duty of the motor here will be to propel the train with engines coupled on but not in operation through a tunnel about 6,000 feet long.

The conditions require the motors, which will weigh about 80 tons and have a capacity of about 1,200, to propel a 1,200 ton freight train up a grade of 42 feet to the mile at a speed of 15 miles. Passenger trains of 450 tons weight must be regularly started from rest twice in the tunnel on this grade, and in an emergency must start the freight train. The draw bar pull under regular duty, and when not starting, may be as high as 32,000 pounds.

Perhaps the traffic from New York to Philadelphia affords as good an example as any of what may be done on regular passenger service, provided the track is clear enough.

For this I, some three years ago, and again in the *Forum* of September, 1891, outlined an electric express service with a method of supply through a rod carried above the car and a return circuit through the rails and earth.

The current was to be supplied from one or more central stations equipped with high-class triple expansion engines, driving multipolar dynamos directly coupled. What the electric engineer, and the railroad man as well, need to know is whether the electromotive force required on the line and the number of stations necessary would be prohibitory.

No attempt was made at an excess of speed, but I confined myself to the average speed of a mile a minute for a distance of 90 miles, and considered a through service only. I assume a total weight of copper of only about two-thirds that which exists on the long distance telephone line between New York and Boston. The trains were to be two car units leaving every 10 minutes.

I found with these conditions the stations and potentials would be about as shown in the following table:

Station.	Miles apart.	Potential. 2-wire.	Potential. 3 wire.
1		3,600	1,800
2	45	1,800	900
3	30	1,200	600
4	22½	900	450

If the three-wire system is used, that is, the rails as a compensating conductor between two trolley rods, then with only two stations 42 miles apart it is seen that the potential is less than 1,000 volts, and this we undoubtedly can handle.

I am not prepared to say that we may not use even a high pressure, because I believe whatever is demanded in the interests of economy, all things being considered, will be used; but if we can reduce the potential to perfectly safe and reasonable limits by multiplying the number of stations, then those stations should be increased, so long as the increase does not seriously effect the general expense of working. On a service of this character, where I have made the conditions distributed work and the dispatching of units at brief intervals, which conditions, I repeat, are absolutely necessary if we are to consider long distance transportation by electricity, such increase of stations as is advisable will not increase the cost of central station operation.

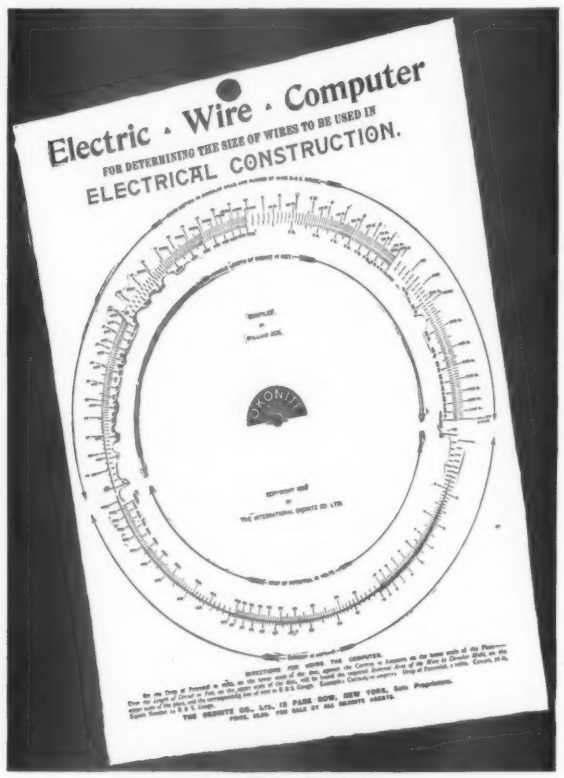
Such is the work before you; a work well meriting your best efforts, yet it is well to temper your enthusiasm with prudence.

Limit your attempts to the solution of those problems which will prove of practical benefit.

Do not chase rainbows; they are beautiful and poetic, but they have small place in the world's economies.

Remember that neither sentiment nor ignorance are winning cards, but lessened costs of operation for equivalent duty and increased returns on invested capital.

All this is said in no spirit of discouragement, for I yield to no man in my confidence in the future of electric traction. No new field is so rich, none more pregnant with great possibilities, but the growth of the work will be more expeditious and healthy if we separate the visionary from the real, the impracticable from the practicable.


Electric · Wire · Computer
FOR DETERMINING THE SIZE OF WIRES TO BE USED IN
ELECTRICAL CONSTRUCTION.
OKONITE
DIRECTIONS FOR USING THE COMPUTER.
THE OKONITE CO., Ltd., 13 PARK ROW, NEW YORK, Sole Proprietors.
PRICE, 10 CTS. FOR SALE BY ALL OKONITE AGENTS.

A NEW WIRE COMPUTER.

Thomas T. Dennis, one of the best known telegraphers in the country, died recently in New York. For many years he had been in charge of the pneumatic tubes of the Western Union Telegraph Company's office. In addition to being an expert telegrapher, he was a mechanical genius. As a member of the United States Military Telegraph Corps he served during the War of the Rebellion, principally in the West.

A New Electric Wire Computer.

The application of scientific principles to practical uses involves the frequent use of formulas, and in no branch is this perhaps more exemplified than in the case of electricity, in which the constantly recurring formulas demanding solution are a continual source of drudgery to the electrician. Anything, therefore, which will tend to simplify necessary but unpleasant work, must be hailed with delight. Diagrams have in many cases been made use of, but they require too much care in following out the various lines representing the different factors.

We present to our readers a device of another kind, compiled by Mr. William Cox, by means of which the sectional area and the number of wire suitable for lighting and other purposes is almost obtained.

It consists of a suitable foundation plate, with a revolving disk about eight inches in diameter, both graduated in accordance with the factors of the formula whose solution it gives.

This is the well-known one

$$\text{C. M.} = \frac{l \times c \times}{v} 10.8$$

in which l equals whole length of circuit in feet; c equals current in amperes; v equals drop of potential in volts; C. M. equals sectional area of suitable wire in circular mills.

We will illustrate the method of using this computer by the following example, in which we have 76 feet as the whole length of circuit, current of 10 amperes and loss of two volts: Turn the disk round until the division representing two volts is opposite and coincides with the one representing 10 amperes. We shall now find, on the outer upper scale, 4,100 circular mills, which corresponds to No. 14 wire, B. & S. gauge. This is, therefore, the number of the wire suited to the circumstances. Mr. Cox has sold his invention to the International Okonite Company, Limited, 13 Park Row, New York, to whom all inquiries concerning the same should be addressed.

The Erie Telegraph and Telephone Company.

The Erie Telephone Company declares a dividend of one per cent. for the quarter, payable August 15 to stock of August 6, thus disposing of the rumors of a reduction. There have been offers to sell this dividend for 87½ cents. The various sub-companies report for three months ended June 30, as below:

Quarter, June 30.	1892.	1891.	Increase.
Income	$226,352	$208,782	$17,570
Exp. and div.	218,399	198,000	20,398
Balance	$7,952	$10,785	*$2,830
Div. received	55,055	52,287	2,768
Div. paid	48,000	48,000	....
Surplus	$7,055	$4,287	$2,768
Total surplus	15,007	.....	.....
Subscribers added.	183	163	20
Connected June 30.	14,429	13,539	890

* Decrease.

It is officially stated that the Erie Telephone sub-companies have already put in their underground plants at Minneapolis, St. Paul and Cleveland, at a cost of $400,000, since the American Bell Telephone Company participated in dividends. Whenever an increase of sub-companies' stock has been made the Erie and American Bell Companies have taken the new stock in proportion to their holdings. The Erie, in order to provide funds to assume its proportion of this outlay above earnings, has borrowed, at a low rate of interest, $125,000. The sub-companies by their contract are prohibited from borrowing, and do not owe one dollar. The sub-companies have voted to build considerable long distance metallic circuits. This and the extensions necessary will require further increase of capital of the sub-companies, to be taken as heretofore by the Erie and Bell. It is thought that Erie in the next five years may require only $200,000 above its earnings to fully equip its entire territory with metallic circuits. This would make a temporary indebtedness of about $325,000.

The telephone company at Decatur, Ill., will expend about $12,000 in cable improvements.

ADVANCE INFORMATION.

New Electric Companies Formed and Important Constructions Projected.

VALUABLE INFORMATION FOR MANUFACTURERS AND DEALERS.

We publish below the earliest information obtainable relating to new electric railways, new electric light companies and projected electric construction of all kinds. Every reader will find these columns of special interest, and manufacturers and supply houses will receive many valuable suggestions looking to new business by carefully watching this department in the ELECTRICAL REVIEW from week to week:

New Electric Railways.

OSKALOOSA, IA.—A mortgage has been executed by the Consolidated Street Railway and Light Company, of Oskaloosa, Iowa, to the State Trust Company, of New York; amount, $166,000. All equipment material contracted for and work upon reconstruction being rapidly pushed to open road September 1. Total mileage, 10 miles.

SALINA, KAN.—The Consolidated Street Railway and Light Company, of Salina, Kansas. Incorporators, C. L. Baum, Salina, Kan.; E. H. Chandler, Charles Ffrench, William Thomas and Silas Porter, Kansas City, Kan.; capital, $100,000. Term of franchise, 47 years. Directors, C. L. Baum, Salina, Kas.; Eli H. Chandler and Charles Ffrench, Kansas City, Kan.; Alexander Simes and H. L. Chandler, Philadelphia, Pa. Line four miles in length. Information to be had from C. L. Baum, Salina, Kansas, or C. E. Jones, No. 207 Walnut Place, Philadelphia.

BOONE, IOWA.—The Boone and Boonesborough Street Railway, 2½ miles in length, has been purchased by E. H. Chandler and Charles Ffrench, of Kansas City, Kan.; C. A. Ross, of Kansas City, Mo.; Chas. E. Hart, of Joplin, Mo.; Alexander Simes, H. L. Chandler and C. E. Jones, of Philadelphia, Pa. The same gentlemen have secured a 25 year light franchise from the city of Boone. The road purchased will be extended three miles, equipped electrically and a lighting plant for the city installed. Information to be had from C. E. Jones, No. 207 Walnut Place, Philadelphia.

PHILADELPHIA, PA.—Under the charters of the Fairmount Park and Haddington, Elmwood and Fairmount Park, and the Philadelphia and Bryn Mawr Passenger Railway Companies, an electric trolley railway system will be established between West Philadelphia and several points in Montgomery county. The president of the three companies is Samuel F. Gillis, and the directors are Geo. W. Seltzer, James Jarden, Jr., Adolph Hermann and Charles F. Trego, all of Philadelphia.

LARAMIE, WYO.—A new franchise for an electric street car line has been granted the Laramie Tramway Company.

ASHLAND, WIS.—The Ashland Lighting and Street Railway Company has let the complete contract for changing the horse car system to an electric line to the Thomson-Houston Electric Company, of St. Paul. The cost of the change is estimated at $150,000.

CANANDAIGUA, N. Y.—Charles C. Sackett has purchased the stock and appurtenances of the Canandaigua street railroad for $32,000. There will be no change in the motive power nor length of the road until Autumn, when it is possible the line will be extended and electricity adopted.

SPENCER, MASS.—Boston capitalists have been looking over the route from Spencer to North Brookfield with a view to building an electric railway between the two towns.

BLOOMINGTON, ILL.—The Citizens' Railway Company has been granted a franchise to construct an electric road in this city.

LINCOLN, NEB.—The syndicate which recently bought the Lincoln City Electric Railway will expend $100,000 in extensions of the system.

PORT GARDNER, WASH.—Articles of incorporation of the Port Gardner, Lake Stevens and Eastern Railroad Company, with a capital of $250,000, have been filed. The incorporators are John F. Hart and J. M. Davis, and the principal objects of the incorporation are to build and operate a railroad between Everett and Lake Stevens, and to erect and conduct electric plants for manufacturing and lighting.

ASHLAND, WIS.—The horse car system of Ashland is to be replaced by an electric line, the company having let a contract to the Thomson-Houston Company for $150,000. The work is to be done in four months.

HUNTINGTON, IND.—An electric railway is wanted in this place.

CHICAGO, ILL.—The South Chicago City Railway Company will run between South Chicago and the World's Fair grounds. The line will be 12 miles long.

ROCHESTER, N. Y.—There is a scheme on foot to build another electric railway to the lake. The projected line will be an extension of the Sophia street route of the Rochester Electric Railway, from its present terminus at the Driving Park, and the route chosen is along the new boulevard to the Little Ridge and so on to the lake, terminating at the Greenleaf farm.

LANSING, MICH.—The Capital Street Railroad Company has been organized with a capital of $25,000. An electric line will be built from the city to the Agricultural College.

FLINT, MICH.—The city council has granted a franchise for 30 years to an Ohio syndicate to construct an electric street railway. The principal promoters of the scheme are David Joy and Charles A. Stockton, of Findlay, Ohio.

VICKSBURG, MISS.—The Hill City Street Railroad and Electric Company, capital, $100,000, has been organized to build an electric belt line railroad. Incorporators, G. P. H. Rector, F. Speed, M. Dabney and H. C. McCabe.

SANFORD, ME.—The Monsam River Railroad Company has been organized and will construct an electric line from Springvale to Sanford.

Reorganization.

NORTH ATTLEBORO, MASS.—The North Attleboro Steam and Electric Company has reorganized as follows: President, H. M. Daggett, Jr.; treasurer, W. M. Otis, of Providence; clerk, C. T. Guild.

Electric Lighting.

BERKELEY, CAL.—A. A. Osborn held a contract to light the town with electricity until August 1. The town trustees are now considering whether the town should run the plant or whether the contract should again be let. The town owns the plant, and has simply contracted with Osborn to run it for a certain sum. Several citizens are in favor of enlarging the plant and have the town run it. The plant will certainly have to be enlarged in order to furnish light to Lorin.

MIDDLETOWN, PA.—At a special election it was decided to light the borough by electricity.

PERRY, N. Y.—The Perry Electric Power and Light Company have got their franchise and a contract to light this place.

ORANGE, MASS.—The Orange Electric Light Company is sold and the new management assume control at once, as the papers have passed. Local capital and management will have charge, and it is promised that the service will be better and cheaper than before.

COATESVILLE, PA.—The Coatesville Heat and Power Company has purchased a tract of land on which a plant will be erected for the purpose of supplying the town with electric light.

KENNEBEC, ME.—It is understood that the Kennebec Light and Heat Company, of Augusta, have purchased of Charles Doughty his electric light plant.

RUMFORD FALLS, ME.—The Rumford Falls Light and Water Company has been organized with a capital of $100,000. Its officers are Hon. Geo. D. Bisbee, president; Hon. Waldo Pettengill, treasurer; D. W. Snow, clerk, and the board of directors includes Messrs. Bisbee, Pettengill, Hugh J. Chisholm, Daniel F. Emery, Jr., and Hon. F. E. Richards. This company will put in water works and electric lights in the business section during the present season.

WICHITA, KAN.—The Wichita Gas and Electric Light Company will enlarge its plant. Henry C. Scott is president of the company.

SACO, ME.—The Yuma Water and Light Company has been organized with $100,000 capital, of which $500 is paid in. The officers are: President, Charles P. Hemenway, of Boston, Mass.; treasurer, John Dodd, of Boston, Mass.

LUDLOW, KY.—Articles of incorporation of the Ludlow Electric Light, Power and Manufacturing Company have been filed. The incorporators are J. S. Weaver, H. Boutet, E. A. Bradley, J. C. Terrill and J. J. Sullivan. The capital is $100,000. The company will light Ludlow.

MANCHESTER, VT.—The Vermont Electric Company has secured business to the amount of $10,000 at Burlington, which will assure the building of the plant for the utilization of the power at Winooski Gorge.

FREEPORT, N. Y.—The Queens County Electric Light and Power Company has been organized to light the streets, stores and public buildings of Freeport, Baldwins and Rockville Center, L. I.

SPRINGFIELD, MASS.—A new 500 horsepower engine will be put in by the Electric Light Company this Fall, and other generators for the street railway company's use have already been added. There are now machines enough to run 8,000 incandescent lamps.

KISSIMMEE, FLA.—The Kissimmee Improvement, Manufacturing and Electric Light Company has applied for a charter. Its board of directors comprise well known business men of Florida; A. E. Drought, M. Katz, W. B. McKinson, J. H. Dawe and J. E. Coggswell.

KANSAS CITY, KAN.—The Fort Wayne Electric Company is seeking a franchise and location for a plant in this city.

CANAJOHARIE, N. Y.—Mohawk Valley Electric Light and Power Company; capital, $40,000. Promoters, Geo. H. Smith, Canajoharie, N. Y.; David Zieley, Jr., Brooklyn, N. Y.; Edwin N. Sanderson, Fort Edward, N. Y.

LOGAN, OHIO.—The Citizens' Electric Light Company; capital, $15,000. Promoters, Henry Lutz, Geo. H. Hartman, Lafayette Wamen, William H. Hartman and W. H. Lautz.

LOWELL, MICH.—Lowell Water and Light Company; capital, $200,000. Promotors, Edwin E. Sweet, A. C. Schell, Jno. E. Man.

NAPERVILLE, ILL.—The Pittsfield Electric Company; capital, $20,000. Incorporators, Geo. E. Royce, Alvin Scott, Jr., and Alvin Scott, Sr.

WAITSBURG, WASH.—The Waitsburg Light and Power Company has been organized with a capital of $25,000.

EVERETT, WASH.—The Everett and Lake Stevens Water and Electric Company has been formed with a capital of $250,000.

SILVER PLUME, COLO.—The Silver Plume Electric Light and Power Company; capital, $25,000. Promoters, Ensign S. Wright, Thos. Cornish, Ernest Le Neve Foster. To supply electric light and power to the city of Silver Plume, Colo.

CHILLICOTHE, O.—L. T. Neal has been granted a franchise to build an electric plant in opposition to the Juneman Electric Light Company.

BUFFALO, N. Y.—The consolidation of the Brush, Thomson-Houston and Edison Electric Light Companies has been consummated. The new company is to be known as the Brush General Electric Company, Daniel O. Day, president; Chas. R. Huntley, manager; capital, $1,800,000.

TITUSVILLE, PA.—The Titusville Electric Light and Power Company; capital, $100,000. Directors, Frank R. Davis, Pittsburgh; B. T. Kraffart, Arthur Mandell, Titusville; Joseph Buffington, Kittanning.

NUTLEY, N. J.—The Excelsior Electric Light Company, of Harrison, N. J., and the Nutley Electric Lighting Company have been consolidated, the owners of the latter, Messrs. Eli Teeter, Chas. McIntire and F. Willard, purchasing the first named. The new company will put in about 3,000 incandescent and 500 arc lights, and will furnish lighting for Harrison, Kearney, Belleville, Nutley and Essex.

DUNELLEN, N. J.—The Edison Electric Light Company has been merged into the North Plainfield Electric Light Company, and both concerns are now under the control of Chas. Sebring and W. R. Codington. The Dunellen plant is to be removed to the North Plainfield station.

ROCHESTER, N. Y.—A certificate of an agreement for the consolidation of the Rochester Gas Company, the Edison Electric Illuminating Company, of Rochester, and the Rochester Electric Light Company, under the name of the Rochester Gas and Electric Company, was filed with the Secretary of State at Albany, on August 4. The capital of the consolidated corporation will be $4,800,000.

BERWICK, ME.—The Berwick Electric Light Company, with a capital of $25,000, has been incorporated.

BRADDOCK, PENN.—An application will be made September 3 for a charter for the People's Electric Company. The gentlemen interested are W. J. Vance, A. T. Reid, D. D. Willson, E. J. Snail, S. D. Hamilton, A. M. Carline, J. K. Mills and L. E. Baker. It will be a competitor of the Citizens' Company and will have a capital stock of $75,000.

FREMONT, COLO.—Since the towns of Fremont and Cripple Creek were incorporated applications have been made for franchises for electric plants.

CADIZ, O.—A company, with a capital stock of $15,000, has been organized to build an electric light plant at Cadiz.

TEXARKANA, ARK.—The Texarkana Gas and Electric Light Company has been granted authority to do business in Texas.

CARSON CITY, MICH.—The Carson City Electric Light and Power Company; capital, $10,000.

Receiver Appointed.

NEW YORK, N. Y.—James J. Nealis has been appointed receiver for the Barr Electric Manufacturing Company, of 17 Broadway, on the application of Edward McGill, a judgment creditor. The company manufactures electric cigar lighters.

ADVANCE INFORMATION.

Telephone and Telegraph Companies.

CHICAGO, ILL.—The Commercial Telegraph and Telephone Exchange; capital, $100,000. Incorporators, Frederick T. White, Frank D. Concannon and L. B. Hillis.

CHICAGO, ILL.—The Electric Annunciator and Indicating Door Plate Company; capital, $50,000. Incorporators, Michael McInerny, Edward J. Dunn, Martin J. Dwyer and John McKeough.

REDWOOD FALLS, MINN.—The Redwood Falls Telephone Company has been incorporated with $4,000 capital stock.

MONTREAL, P. Q.—The Merchants' Telephone Company, of Montreal, has given notice that application will be made for the issuing of letters patent. The capital stock is $100,000, divided into 4,000 shares of $25 each. The following gentlemen are the petitioners: Frs. X. Moisan, merchant; Ls. E. Beauchamp, merchant; Odilon Vanier, merchant; Herbert M. Linell, electrician; James E. Macdougall, Joseph Archambault, merchant; Chs. F. Beauchamp, electrician, all of Montreal.

WORCESTER, MASS.—The Bacon-Tyler Company has just been incorporated for the manufacture of the Bacon telephone index. F. L. Parker is president, W. H. Tyler, vice-president and C. M. Rogers, treasurer. The manufacture of the telephone index, which is being rapidly adopted, is a Worcester industry and bids fair to be an industry of importance. Nearly all the principal cities of New England have adopted the invention, and it is to be placed in many of the larger cities of the West.

WESTMORELAND, KAN.—The Westmoreland and Blaine Telephone Company was chartered yesterday; capital, $1,500. Directors: M. A. Tibbetts, A. B. Pomeroy, M. V. Ingraham and O. G. Etchison, of Westmoreland, and M. J. Walsh, of Blaine.

MONTREAL, P. Q.—Messrs. Harvey P. Dwight, Frederick Royer, Geo. B. Perry, of Toronto; Wm. Wainwright, Frederick H. Waycott, of Montreal, will apply for letters patent incorporating them under the name of the Anglo-Provincial Telegraph Company, with a capital stock of $25,000. The principal place of business of the new company will be in Montreal.

BRISTOL, N. H.—The Bristol and Hebron Telephone and Telegraph Company has been organized to build telegraph and telephone line between the two towns.

Manufacturing Companies.

NEWPORT, KY.—The Imperial Primary Battery Company filed articles of incorporation in the County Clerk's office yesterday. The object of the corporation is the manufacture and sale of primary and secondary electric batteries. The capital stock is $150,000. The incorporators are A. G. Corre, J. D. Parker, C. H. Stephens and George P. Quiggin.

BIRMINGHAM, ALA.—F. P. Slosser, M. Maloney and C. P. Jones have applied for the incorporation of the "F. P. Slosser Electric Signal and Alarm Company." The capital stock is $200,000. The object of the corporation is the manufacture of an electric device which Mr. Slosser has patented. The device is intended to warn running trains of the approach of others and thus prevent collisions. The inventor is a well-known citizen of Birmingham.

MENOMINEE, MICH.—Menominee Electric and Mechanical Company, Menominee, capital, $20,000, has been formed.

NEW YORK, N. Y.—The New York Electric Incandescent Lamp Company has been organized at Portland with $2,000,000 capital stock, for the purpose of manufacturing electric lamps. The officers are: President, G. H. Ford; treasurer, G. R. Stone.

WINCHESTER, KY.—The machinery for the electric meter shop has arrived, and Mr. McNeil has gone to Cincinnati to obtain workmen. This will not be the regular factory, but a shop for perfecting the details of the invention. The regular factory has not yet been located. A growing Western city has offered the company a bonus of $10,000 and five acres of ground, but we hope it may be located in Winchester. Among those who have purchased an interest in the firm are N. H. Witherspoon, S. P. Kerr, S. H. Oden, T. Landsberg, Vic Bloomfield and others.

NEW BEDFORD, MASS.—The Suffolk Electric Company, of Boston, has leased of the Jenney Star Electric Company its large factory on North Front street, in this city, and commenced the manufacture of arc lamps under patents of H. Dewar, the superintendent. The first batch of lamps will be shipped in about two weeks. The Jenney Star Electric Company will continue its motor and dynamo manufacture by special arrangement.

Electric Light and Power.

DIXON, ILL.—The plant of the milling company at the water power has been purchased by the Dixon Electric Lighting and Power Company. The price paid was $20,000. The present company will at once utilize the water power and enlarge their plant to furnish power for surrounding mills and factories, and build an electric street railway. A number of small factories will occupy a portion of the plant.

JOPLIN, MO.—The Merchants' Electric Light and Power Company has been incorporated.

SEATTLE, WASH.—Lake Washington Canal and Improvement Company; capital, $5,000,000. Promoters, F. H. Whitworth, F. J. Hamilton, W. J. Jennings.

YOAKUM, TEX.—Blanks Ice, Water and Power Company; capital, $60,000. Promoters, Jas. Blanks, Leonard Isaacs, O. J. Gorman.

MADISON, WIS.—Four Lakes Light and Power Company; capital, $50,000. Promoters, J. Alford, G. H. Shaw and J. Lamont. Incorporation papers sent to J. M. Olin, Madison, Wis.

DULUTH, MINN.—The Hartman General Electric Company is preparing to build at once a large central light and power station. The dimensions contemplated are 175x100 feet, four stories high, with an addition 100x25 feet.

SUPERINTENDENT WANTED.

For a Central Station in Connecticut. Must be a man thoroughly familiar with Arc, Alternating and Direct Incandescence Systems, as well as with outside and inside work, be thoroughly capable of taking entire charge of a Station and able to furnish unquestioned references to that effect. Address, stating full particulars, salary expected, etc.,

"SECRETARY,"
Care ELECTRICAL REVIEW,
13 Park Row, N. Y.

WANTED.—Position as Superintendent of an Electric Light or Power Station by a practical Steam and Electrical Engineer of long and varied experience. References exchanged.

Address, "ENGINEERING,"
Care ELECTRICAL REVIEW, Boston Branch,
620 ATLANTIC AVENUE, BOSTON.

NOTICE.

Notice is hereby given that the City of Springfield, Mo., will receive sealed proposals up to twelve o'clock, noon, of Tuesday, the 6th day of September, 1892, for furnishing said city and the citizens thereof with electric lights.

Specifications and form of proposal will be furnished on application to the City Clerk.

By order of the Council,

C. W. HACKNEY,
City Clerk.

ROBB MACKIE,
Consulting Electrical Engineer,
NEAVE BUILDING,
CINCINNATI, O.

$4,400 CASH

Buys a stock of Electrical Supplies, good will of business, present contracts, etc., if taken at once. Business established in growing town of 39,000. Goods alone inventory $4,600, market value. Copy of inventory confidentially furnished on application. Address,
"BUSINESS,"
ELECTRICAL REVIEW, 13 Park Row, N. Y.

CHANDLER, FFRENCH & CO.,
1st NATIONAL BANK BUILDING,
KANSAS CITY, KANSAS.

ELECTRICAL SECURITIES.

Buy and sell Electric Light and Street Railway Bonds.
Promote and contract for the construction of Electric Light Plants and Street Railways.
Correspondence solicited.

THE DANDY BELL.

Best Bell, pressed metal gong, long phosphor bronze springs and platinum contact points. Most reliable bell in the market. In four sizes, 2½ inches, 3 inches, 3½ inches and 4 inches. Samples sent post-paid to all dealers upon receipt of 50 cents and business card.

THE TIME ELECTRIC CO.,
C. O. BARTLETT, Gen. Manager,
CLEVELAND, O.

MACHINERY IN STOCK.

Engine Lathes, 10 in. x 4 ft.; 11 in. x 5 ft.; 12 in. x 6 ft.; 14 in. x 6 ft.; 16 in. x 6 ft.; 18 in. x 8 ft.; 20 in. x 8 ft., with tapes attachment; 22 in. x 12 ft. and 14 ft.; 24 in. and 26 in. x 16 ft.; 30 in. x 10 ft. and 18 ft.; 36 in. and 38 in. x 20 ft.; 42 in. x 12 ft.; 27 in. x 28 ft.; 66 in. x 31 ft.; 96 in. x 30 ft. Fox Lathes, 13 in. x 5 ft.; 14 in. x 5 ft.; 15 in. x 6 ft.; 18 in. x 6 ft. Turret Lathes, 12 in. x 5 ft.; 14 in. x 5 ft.; 15 in. and 16 in. x 6 ft.; 18 in. x 6 ft.; 36 in. x 8 ft.

Planers, 16 in. x 16 in. x 3 ft.; 20 in. x 20 in. x 4 ft.; 24 in. x 24 in. x 6 ft.; 30 in. x 30 in. x 6 ft.; 36 in. x 36 in. x 10 ft.; 42 in. x 42 in. x 12 ft.; 44 in. x 48 in. x 22 ft.; 60 in. x 49 in. x 24 ft.

Friction Shapers, 15 in., 16 in., 20 in., 22 in., 32 in.
Crank Shapers, 6 in., 8 in., 10 in., 12 in., 18 in., 16 in., 17 in., 20 in., 24 in., 28 in.
Screw Machines, Nos. 1, 2, 3, 4, with or without Wire Feed.
Screw Machines, Nos. 5, 6, 7, 8, Power Feed.
Presses, Nos. 51, 52, 53, Ferracute; Nos. 1, 2, 3, Stiles & Parker.
5 Lincoln Pattern Millers, No. 2.
Hand Millers, Nos. 1 and 2. 3 Cam Cutters.
Bolt Cutters, ¼ in. to 1 in., ½ in to 2 in.
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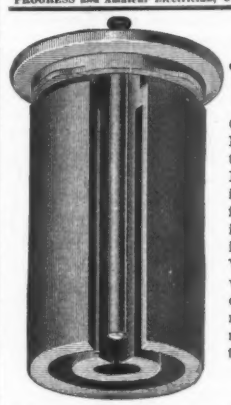

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